Feb. 25, 1930. C. M. PETERSON 1,748,618

MILK DRYING APPARATUS AND PROCESS

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Fig. 1.

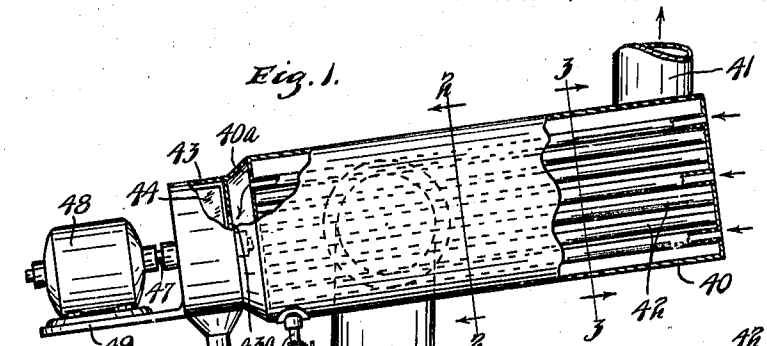


Fig. 2.

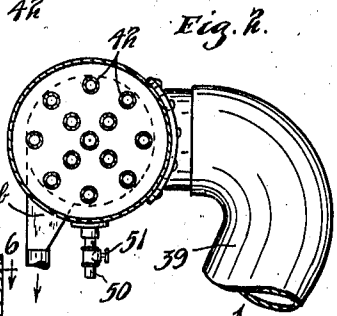


Fig. 5.

Fig. 4.

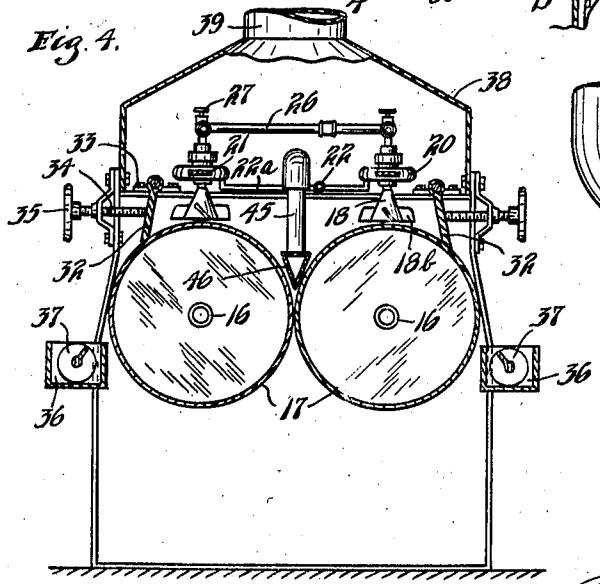
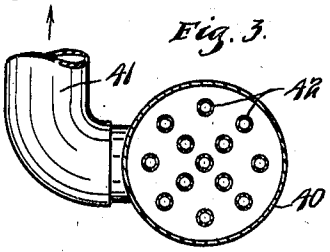


Fig. 3.



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MILK DRYING APPARATUS AND PROCESS

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Fig. 8.

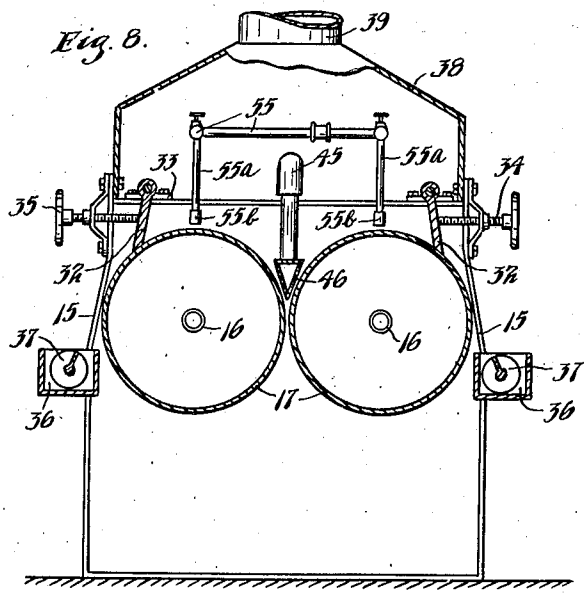


Fig. 6.

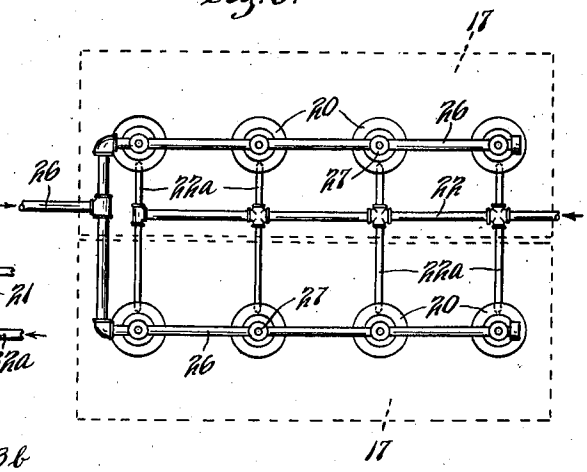
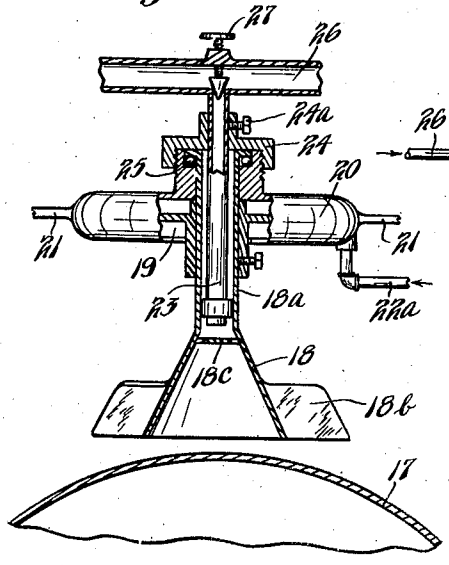


Fig. 7.



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UNITED STATES PATENT OFFICE

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MILK-DRYING APPARATUS AND PROCESS

Application filed October 8, 1926. Serial No. 140,340.

This invention relates to a method and apparatus for drying milk, buttermilk or similar fluid or semi-fluid material. Milk, buttermilk, etc., are now dried in large quantities and the dried milk is a well known commercial product. It is, of course, highly desirable to secure a dried product of high quality in color, flavor and solubility, and it is also desirable and quite essential from a commercial standpoint, that the product be produced in quantity and at a reasonable price.

It is an object of this invention, therefore, to provide a method and apparatus by which the material is dried by being projected mechanically against a heated surface so as to form a thin film on said surface until suitably dried and then removed therefrom.

It is a further object of the invention to provide a method and apparatus by which the material is centrifugally projected in finely divided condition upon a heated surface to form a film thereon, said film being retained on said surface until the material is dried and then removed therefrom.

It is more specifically an object of the invention to provide a method and apparatus by means of which the material is mechanically or centrifugally sprayed in finely divided condition upon one or more heated rolls, to form a thin film on said rolls, said rolls being revolved with said film thereon until the same is suitably dried when the film is removed.

It is another object of the invention to provide a method and apparatus for drying milk, buttermilk or other similar fluid or semi-fluid material, in which the material is forcibly projected upon a heated surface and air under pressure is also delivered toward said surface and in contact with said material to assist in drying the same.

It is still another object of the invention to provide a method and apparatus in which the material is forcibly projected in a fine jet or stream against a moving heated surface and heated air under pressure is also delivered toward said surface and in contact with the material to assist in drying the same.

It is also an object of the invention to provide a method and apparatus in which the fluid material is forcibly projected in a fine jet or stream against the heated surface of one or more revoluble rolls to form a film thereon, heated air under pressure also being delivered to said surface and in contact with the material to assist in drying the same.

It is more specifically an object of the invention to provide a method and apparatus for drying milk or similar fluid or semi-fluid material in which the material is forcibly projected in finely divided condition upon the heated surface of a pair of rolls having their peripheries in close proximity, heated air being delivered toward said rolls and into contact with said material adjacent the line of proximity of said rolls, said air preferably being heated by the heated vapor formed by the milk coming in contact with said rolls.

These and other objects and advantages of the invention will be fully set forth in the following description made in connection with the accompanying drawings, in which like reference characters refer to similar parts throughout the several views and in which:—

Fig. 1 is a view partly in side elevation and partly in vertical section of the apparatus used;

Fig. 2 is a vertical section taken on line 2—2 of Fig. 1, as indicated by the arrows;

Fig. 3 is a vertical section taken on line 3—3 of Fig. 1, as indicated by the arrows;

Fig. 4 is a vertical section taken substantially on line 4—4 of Fig. 1, as indicated by the arrows;

Fig. 5 is a partial view in side elevation of an air projector used, the same being shown on an enlarged scale;

Fig. 6 is a somewhat diagrammatic view in horizontal section taken substantially on line 6—6 of Fig. 1;

Fig 7 is a view in vertical section taken substantially on line 7—7 of Fig. 1, the same being shown on an enlarged scale; and,

Fig. 8 is a view similar to Fig. 4, showing a modified form of the apparatus.

Referring to the drawings, one form of

apparatus for carrying out the method herein disclosed is shown, comprising a frame having the end walls 15 having thereon suitable bearings in which are journaled the shafts 16 carrying rolls or drums 17. The shafts 16 extend in parallel relation and the rolls 17 have their peripheries in close proximity. The shafts 16 are hollow or made of pipes, and steam will be delivered therethrough into the rolls 17, so that the latter will be heated and the material to be dried is forcibly projected in finely divided condition upon the surface of a heated member 17. While various apparatus may be used for this operation, among the forms illustrated are the mechanical or centrifugal projectors 18. The members 18 are of conical or frusto-conical shape, as shown in Figs. 1 and 7, and have hollow spindles 18^a extending upwardly therefrom, to which will be secured some suitable rotating member such as the rotor 19 of the steam turbines 20. The turbines 20 will be suitably supported in frame members 21 extending therebetween, and secured to the end frame members 15. Steam will be supplied to the turbines 20 by a steam line 22 having the branch portions 22^a extending therefrom to the individual turbines 20. The member 18 preferably will have fan blades 18^b extending therefrom about its outer side, so formed as to direct a strong current of air downwardly about said member in the rotation thereof. The member 18 has a plate 18^c adjacent its upper end at the inner side thereof and the material is delivered onto said plate by a feed pipe 23 extending downwardly centrally through spindle 18^a and this feed pipe extends through a packing cap 24 threaded on the top of the turbine casing 20, said cap being secured to pipe 23 by a suitable set screw 24^a. Anti-friction bearings 25 will be carried in the casing 20 on which a spindle 18^a will be supported, the same having a flange extending over said bearings. The pipes 23 for each of the members 18 are supplied with material through a feed pipe 26 and the amount of material flowing into the pipes 23 can be regulated as desired by the adjustable valve 27. The members 18 can be raised or lowered by loosening set screw 24^a. The shafts 16 are rotated to revolve the rolls 17 by the worm wheel gears 28 secured thereto. The worm wheel gears 28 are driven by suitable worm gears 29 carried on a cross shaft 30 which will in turn be driven by the pulley 31 adapted to receive a belt from any suitable motor. The material is projected onto the rolls 17 and forms a film thereon, which film is dried as the rolls revolve and the same is removed by the scrapers or doctor plates 32 swingingly mounted in bearings 33 secured to the frame and adjustable by means of the screws 34 having thereon operating hand wheels 35. The material is received in troughs 36 having therein the conveyors 37 by which the material is delivered at one end of the machine.

The frame 15 has mounted thereon a hood 38 having side and end portions enclosing the feeding pipes for the material and having upwardly inclined top portions from which extends upwardly a conduit 39. A drum 40 is provided which will be suitably supported above the hood 38, and with which the conduit 39 communicates and to which the latter is connected, as shown in Fig. 2. The drum 40 has an outlet conduit 41 at its upper end. A plurality of tubes 42 are disposed in and extend lengthwise of the drum 40 preferably having their ends flanged in the upper end of drum 40 and a partition 40^a at the lower end thereof. A casing 43 is secured to one end of the drum 40 spaced some distance from partition 40^a, which casing has mounted therein a fan 44. The casing 43 has an opening 43^a forming the eye of the fan 44 and said casing has an outlet or discharge portion 44^b. The portion 44^b is connected by a suitable conduit 45 to a hollow member or box 46. The pipe 45 has a suitable regulating valve 45^a therein. While this box may be variously formed, in the embodiment of the invention illustrated it is shown as substantially triangular and having side portions 46^a disposed closely adjacent the surface of rolls 17 adjacent their line of proximity, the said box being disposed in the trough-like portion between the rolls 17 as shown in Fig. 4. The sides 46^a are formed with a multiplicity of fine perforations extending therethrough. The fan 44 is carried on a shaft 47 journaled in casing 43, and connected to the driving shaft of a suitable motor 48 mounted on a bracket 49 extending from casing 43. The drum 40 is provided at its lower end with a drain pipe 50 having therein a suitable control valve 51.

In Fig. 8 a slightly modified form of the invention is disclosed, which has the structure already disclosed with the exception of the means including parts 18 to 26 described, for delivering the material to the rolls 17. In lieu of these parts a feed pipe 55 is provided having discharge pipes 55^a spaced longitudinally of the rolls 17. The discharge pipes 55^a have nozzles 55^b at their lower ends and the material which is placed under heavy pressure is sprayed through the nozzles 55^b onto the rolls 17. The structure shown in Fig. 6 has the hood 38 with the pipe 39 extending therefrom, which will be connected as shown in Fig. 1, with the drum 40 and the air pipe 45 from the drum 40 will extend into the hood 38 and be connected with the air delivering means 46 as already described.

In carrying out the method of the present invention, in the apparatus shown in Figs. 1 to 7 the material is supplied through the pipe 26 and delivered through the feed pipes 23 to the members 18. The material will

flow onto the plate 18[c] and will be deflected thereby onto the inner surface of the member 18. The members 18 will be revolved at a very high speed by the turbine rotors 19 and the material will be centrifugally thrown downwardly and outwardly from the surfaces of members 18. The fan blades 18[b] will cause a strong current of air downward about the members 18 and this will further deflect the material downward. The material is thus projected in a conical film or in a very finely divided condition and forcibly projected against the surfaces of the drums 17. These surfaces, as stated, will be heated and the material being thrown against said surfaces will adhere thereto and form a film thereon. By forcibly projecting the material it is caused instantly to adhere to the heated surfaces and does not move about thereon or have a blistering effect. The material being projected onto the rolls thus forms a film thereon and the surfaces of the rolls or drums 17 being quite hot, the moisture is evaporated from the material. This causes quite a large quantity of steam or vapor to rise from the rolls which passes upwardly in hood 38 and into the pipe 39. From the pipe 39 this steam or vapor which is quite hot passes into the drum 40 and about the tubes 42, the same passing out through the outlet 41. The tubes 42, of which there will be quite a large number, usually are in practice about one inch in diameter and preferably formed of copper. These tubes will become heated by the steam and vapor passing through drum 40. The motor 48 is driven, revolving fan 43 which draws air through the tubes 42 and discharges this air through the pipe 45. The air passing through tubes 42 will be heated and delivered forcibly or under pressure into the box 46 and out through the sides 46[a] thereof. The air can be regulated as desired by the valve 45[a]. This air will thus be delivered toward the surfaces of the drums 17 and against the material. Some of the fluid material often collects in the trough formed between the rolls 17 at their line of proximity and the air passing through the sides 46[a] will be delivered in contact with this material. The heated air passing from member 46 assists greatly in drying the material and this air passes upwardly through the hood 38 carrying therewith a great deal of the moisture. The use of the heated air delivered toward the heated surfaces and in contact with the material greatly increases the production of the dried material. This feature also adds greatly to the efficiency of the apparatus, as the heat of the steam and vapor rising from the rolls is thus utilized and no extra expenditure is necessary for heating the air.

In carrying out the method in the apparatus shown in Fig. 8, the material is first placed under heavy pressure of from 500 to 2500 pounds per square inch, and is delivered under this pressure into the feed pipe 55. The material passes from this pipe to the auxiliary pipes 55[a] and to the nozzles 55[b]. The nozzles 55[b] are of a construction to discharge a fine jet of material which is thus projected forcibly against the surfaces of the rolls 17. The material thus instantly adheres to the rolls and forms a film thereon. Air is also delivered between the rolls through the member 46 as already described and the material is quickly dried. The material delivered to the rolls adheres to the rolls and travels therewith as the rolls are revolved and is removed from the rolls by the plates 32. The apparatus and method have been so developed that the dried material of high quality is taken off the rolls in the form of heavy sheets. With rolls only 26 inches in diameter, a production can easily be maintained in excess of 150 pounds of dried material per hour.

From the above description it is seen that applicant has provided an extremely efficient method and apparatus for drying milk, buttermilk or similar fluid or semi-fluid material. On account of the material adhering effectively to the rolls, the rolls can be highly heated and revolved at comparatively high speed. The material is thus perfectly dried and removed from the rolls before the same has any chance to scorch or burn. As above stated, the production is greatly increased by delivering the heated air to the material on the heated surface. The use of the air renders it much easier to prevent overheating. If the material is overheated on the rolls, it is discolored and the albumin in the milk is coagulated and thus rendered insoluble. The overheating is apt to occur when some of the fluid collects between the rolls and the air being delivered at this point and passing through the material carries away the heat. The material is thus more quickly dried and carried along with the rolls. It has been found that the temperature to which the material is heated can be regulated by merely regulating the air supply.

By the use of the air, the solubility of the product is also increased. The air supply also tends to carry away any foreign odors in the milk and the milk is thus rendered pure and sweet. The large quantity of air used also in effect greatly increases the evaporating surface and as stated above, the production is greatly increased by the use of the air. The described process and apparatus therefore, greatly increases the speed of production, improves the product and efficiently uses the fuel. The method and apparatus have been amply demonstrated in actual practice and found to be very successful and efficient.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the apparatus, and in the steps and sequence of steps of the method without departing from the scope

of applicant's invention, which, generally stated, consists in a method and apparatus capable of carrying out the objects above set forth, such as disclosed and defined in the appended claims.

What is claimed is:—

1. An apparatus for drying milk or other similar fluid or semi-fluid material having in combination, a member having a surface, means for heating said surface, means for forcibly projecting said material in finely divided condition against said surface to form a film thereon, means for collecting the heated steam and vapor rising from said surface, a member connected to said last mentioned means through which said heated steam and vapor is passed, means for drawing air through said member to heat the same, and means for delivering said heated air under pressure adjacent said surface and into contact with said material to assist in drying the same, and means for removing the material from said surface.

2. An apparatus for drying milk or other similar fluid or semi-fluid material having in combination, a drum, means for heating the peripheral surface of said drum, means for forcibly projecting the material in finely divided condition against said drum to form a film thereon, means for collecting the heated steam and vapor rising from said drum, a member through which said heated steam and vapor is passed, means for drawing air through said member to heat the same, and means for discharging said air under pressure toward the surface of said drum and into contact with the material to assist in drying the same, and means for removing the material from said drum.

3. An apparatus for drying milk or other similar fluid or semi-fluid material having in combination, a pair of revoluble drums having their peripheral surfaces in close proximity, means for forcibly projecting the material in finely divided condition against the surfaces of said drum along lines spaced from said line of proximity, means for heating the peripheral surfaces of said drums, means for rotating said drums, a hood extending about and above said drums for collecting the steam and vapor rising therefrom, a drum through which said heated steam and vapor is passed, a plurality of tubes extending through said latter drum, means for drawing air through said tubes to heat the same, and means for delivering said air under pressure toward the surfaces of said drums adjacent the line of proximity thereof, and means for removing the dried material from said drums.

4. The method of drying milk or similar fluid or semi-fluid, non-sticky material, which consists in forcibly projecting the material downwardly centrifugally in finely divided form upon the top of a rotating heated drum to form a film thereon, directing heated air into contact with said material on said drum at the upper portion of said drum, retaining said material on said drum for a partial revolution thereof to dry said material and removing said material from said drum.

5. An apparatus for drying milk or other similar fluid or semi-fluid material, having in combination a revoluble drum, a centrifugal distributor disposed above said drum and comprising a downwardly flaring member revoluble about a vertical axis, a conduit for feeding material to said distributor, means for rotating said distributor at high speed whereby material fed therethrough is forcibly projected in finely divided condition against said drum, means for heating said drum, means for rotating said drum and means for removing the material from said drum.

6. The structure set forth in claim 5, said flaring member having means thereon for directing a current of air downwardly to assist in projecting said material.

7. An apparatus for drying milk or other similar fluid or semi-fluid material having in combination, a hollow conical member disposed about a substantially vertical axis, a conduit delivering material to the inner side of said member, means for rotating said member at high velocity whereby said material delivered to the inner surface thereof is projected downwardly centrifugally in finely divided condition and a member having a moving surface disposed below said conical member to receive the projected material thereon and means for heating said surface.

8. The structure set forth in claim 7, said conical member having a plurality of plates extending outwardly from its outer side acting as a fan to assist in projecting the material downwardly.

In testimony whereof I affix my signature.

CHRIS M. PETERSON.