S. M. DICK.

EVAPORATING APPARATUS.

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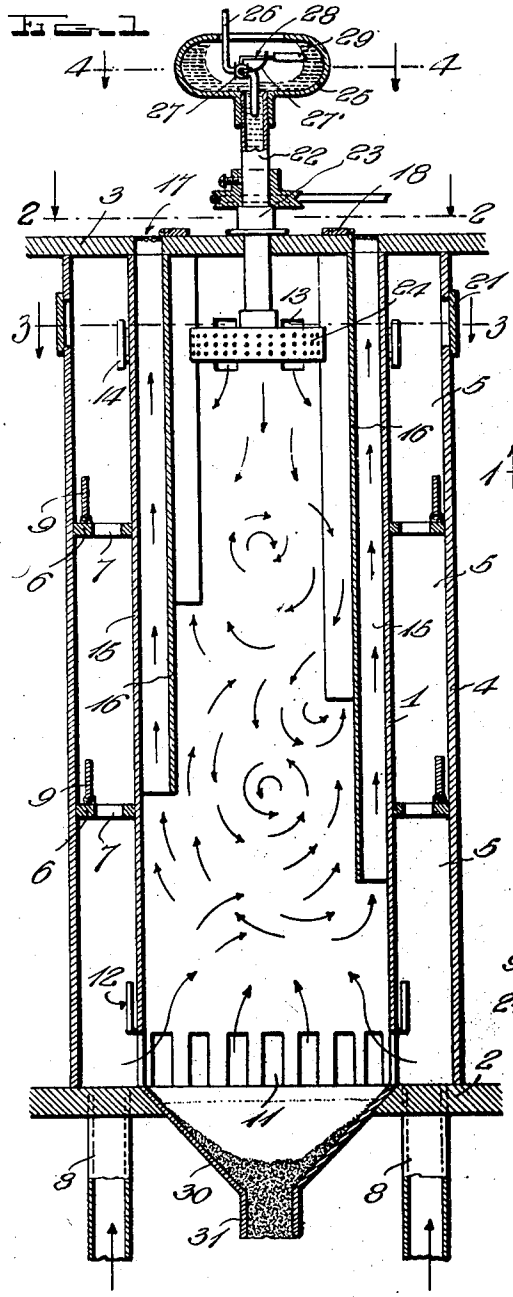
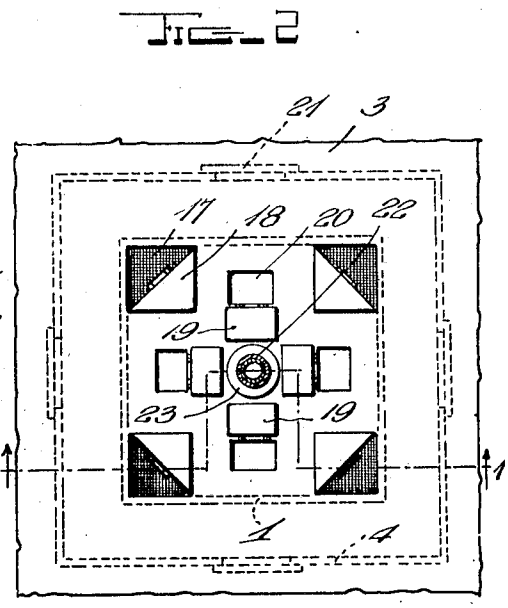
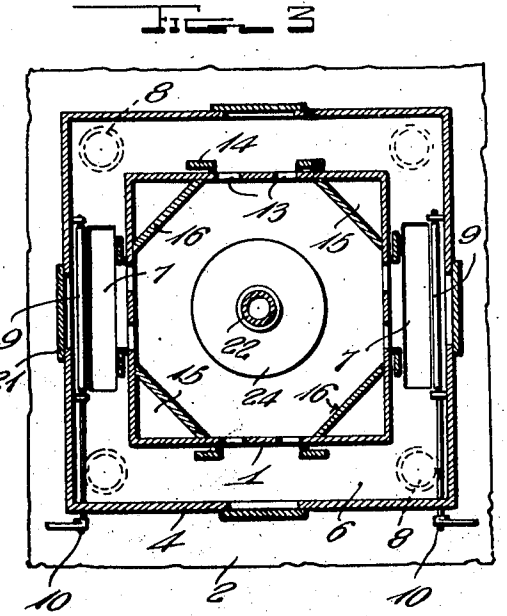
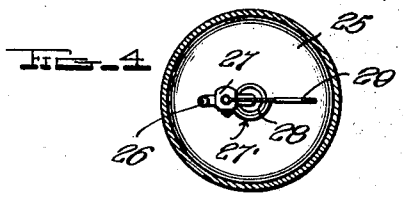
1,298,470. Patented Mar. 25, 1919.









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UNITED STATES PATENT OFFICE.

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EVAPORATING APPARATUS.

1,298,470. Specification of Letters Patent. Patented Mar. 25, 1919.

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To all whom it may concern:

Be it known that I, SAMUEL M. DICK, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Evaporating Apparatus; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The principal object of my invention is to provide an efficient evaporating apparatus which may be advantageously used in the manufacture of dairy and other food products.

A further object is to so construct the one apparatus as to permit of the manufacture of different products varying in moisture content from a comparatively dry milk powder to a condensed or evaporated milk of preferred consistency.

In carrying out the above objects, a vertical cell is employed, the milk or other liquid being sprayed by a centrifugal atomizer into the upper end of said cell and being subjected to differently moving hot air currents supplied from hot air compartments surrounding said cell and communicating therewith at different elevations; and further objects are to provide novel means for controlling the temperatures of the several compartments, to increase the efficiency of the hot air currents by a novel arrangement of outlets therefor, and to provide means for automatically cutting off the supply of liquid to the atomizer in case such supply is more rapid than the discharge of said atomizer.

With the foregoing general objects in view, the invention resides in the novel features of construction and unique combinations of parts to be hereinafter fully described and claimed, the descriptive matter being supplemented by the accompanying drawings which form a part of this specification and in which:

Figure 1 is a vertical section of the improved apparatus on the plane of the line 1—1 of Fig. 2; and

Figs. 2, 3 and 4 are horizontal sections on the planes of the lines 2—2, 3—3 and 4—4 respectively of Fig. 1.

In the drawings above briefly described, the numeral 1 designates a vertical preferably rectangular cell extending from a lower floor 2 of a building to the next floor 3 of the same, said cell being constructed of any preferred heat resisting material and in any appropriate size.

A casing 4 surrounds the cell 1 at a suitable distance therefrom and the space between said cell and casing is divided into a plurality of hot air compartments 5, by horizontal partitions 6, said partitions having a suitable number of openings 7 whereby the several compartments may communicate. Hot air under pressure is supplied to the lowermost of the compartments 5 by means of one or more ducts 8 and in order to control the amount of such air entering the other compartments, the openings 7 of the partitions 6 are provided with suitable shutters or dampers 9 which may be operated by any preferred means such as the rock shafts 10 shown most clearly in Fig. 3. The air supplied from the ducts 8 may be of any suitable temperature, but in all cases this temperature will be low enough to prevent possible cooking of the contents of the cell 1.

Establishing communication between the lowermost of the compartments 5 and the lower end of the cell 1, are suitable openings 11 spaced around the sides of the cell and provided with dampers or the like 12 whereby the amount of hot air entering the lower end of the cell and the points of entrance may be readily under control. Other openings 13 establish communication between the upper end of the cell and the uppermost of the hot air compartments 5, suitable dampers or shutters 14 being also employed for controlling these openings. As the hot air enters the cell 1 under pressure, suitable outlets must be provided for carrying this air from the apparatus, and as means for obtaining the best results, I have shown a plurality of vertical outlet passages 15 leading through the upper floor 3 and having their lower ends disposed in vertically spaced planes as will be clear from Fig. 1. These passages are preferably though not necessarily located at the corners of the cell 1 and are formed by diagonal partitions 16 secured across said corners as shown clearly in Figs. 1 and 3. The upper ends of the passages 15 are provided with fine screens 17 which prevent both the possible escape of solids from the apparatus and the entrance of any exterior dust or other foreign matter. Shutters or

doors are preferably employed to close over the screens 17 when the apparatus is not in use or to regulate the volume of air escaping. Rapid escape of the hot air will not cause the apparatus to evaporate moisture to as great an extent as when such air is trapped longer in the device. Also the movement of the air currents in the cell may be varied by proper use of these doors. Adjacent the doors 18, the floor 3 which forms the top of the apparatus may be provided with doors 19 for closing openings 20 formed therethrough, said openings assisting in controlling the internal temperature of the cell 1 and also serving as ventilating means for such cell when the apparatus is not in use. Other ventilating doors 21 may be provided at the upper end of the casing 4 as required.

A vertically disposed hollow shaft 22 projects into the upper end of the cell 1 and is rotatably mounted in an appropriate bearing 23, the lower end of said shaft having a suitable centrifugal atomizer 24, while the upper end of the shaft is equipped with a bowl 25. A supply pipe 26 passes through the bowl 25 and into the upper end of the hollow shaft 22, said pipe having a valve 27 located in said bowl. An arm 28 extends laterally from the valve 27 and is provided with a wing 29 located in the bowl 25 as shown clearly in Figs. 1 and 4. When the quantity of milk or other liquid fed through the pipe 26 is sufficient only to feed the atomizer 24 properly, the valve 27 remains open, but when the supply of milk is so rapid as to approach overflow, it will accumulate in the bowl 25 and be thrown outwardly in said bowl by centrifugal force as indicated in Fig. 1, so that it is thrown against the wing 29, the result being that this wing is swung horizontally to close the valve and hold it closed until the atomizer is slowed down and the accumulated liquid in the bowl lowers and is discharged. When this takes place, the valve is again automatically opened by spring 27'. The atomizer 24 is preferably located in the same plane with the upper hot air inlet openings 13, although occasion may dictate other appropriate arrangements.

In operation, the shutters 9, 12 and 14 are set properly, said shutters 9 being in most cases so positioned as to permit only a restricted quantity of hot air to pass into the compartments above the lower compartment. The result is that the cooler air entering through the openings 13 will be further cooled by the moisture sprayed from the atomizer 24, so that this air falls within the cell. On the other hand, the hot air entering through the openings 11 rises through the cell and encounters the downwardly moving air, with the result that a whirling action takes place as indicated by the arrows in Fig. 1. Further whirling of the air currents is caused by the fact that the outlet passages 15 have their lower ends located at different elevations. Some of the hot air entering through the openings 11 will escape through the lowermost passage, but the volume of such passage is so restricted as to prevent the escape of all of such air, the result being that although the majority thereof rises into the cell, some of such air will escape through each of the outlets 15. The air descending from the openings 13 also passes out through these outlet passages and a number of crossing and whirling currents of air are thus set up, so that the moisture will effectively be removed from the solids and carried off through the aforesaid passages. The liquid sprayed from the atomizer 13 falls through the currents of hot air and all moisture is thus removed from the solids and butter fat. Actual experience has taught that the particles of milk solids accumulate around the fatty particles until the granules thus formed gather sufficient weight to overcome the upward action of the hot air currents. They then drop by gravity to a hopper or the like 30 at the lower end of the cell 1 and may be carried off in any preferred manner, as by a pipe 31 leading to a receptacle. By properly controlling the temperature of the several compartments 5 and the strength of the draft of hot air entering the apparatus, as well as the points of entrance, the products may be made to vary in moisture content from a comparatively dry powder to a condensed or evaporated milk of any preferred consistency.

From the foregoing, taken in connection with the accompanying drawings, it will be obvious that although my invention is of rather simple and inexpensive nature, it will be highly efficient and durable. Since probably the best results are obtained from the several details shown and described, these details are preferably employed, but I wish it understood that within the scope of the invention as claimed, numerous minor changes may well be made. Also, the apparatus may be constructed of different sizes and shapes to meet various conditions which may be encountered.

I claim:

1. An evaporating apparatus comprising a vertical cell, means for spraying liquid into the upper end of said cell, means for supplying hot air to the upper end of said cell at points spaced around the vertical wall thereof, means for supplying air at a higher temperature to the lower end of said cell at points spaced around said wall of the latter, and air outlets spaced around said wall and also spaced apart vertically.

2. An evaporating apparatus comprising a vertical cell, upper and lower hot air chambers surrounding said cell and means

for maintaining a higher temperature in the lower chamber; together with communicating passages between the lower chamber and the lower end of the cell, and between the upper chamber and the upper end of said cell, means for spraying liquid into the upper end of said cell, and air outlet means from said cell.

3. An evaporating apparatus comprising a vertical cell, means for spraying liquid into the upper end of said cell, a casing surrounding said cell and divided into a plurality of superimposed compartments, means for supplying hot air to the lower compartment, controllable communicating means between said compartments for heating one from the other and controlling the relative temperatures, communicating means between the upper compartment and the upper end of the cell and between the lower compartment and the lower end of said cell, and air outlet means from said cell.

4. An evaporating apparatus comprising a vertical cell, means for spraying liquid into the upper end of said cell, means for supplying hot air to said cell, and a plurality of hot air outlets leading from vertically spaced portions of said cell and spaced around the vertical wall thereof.

5. An evaporating apparatus comprising a vertical cell, means for spraying liquid into the upper end of said cell, means for supplying hot air to the upper end of said cell, means for supplying air at a higher temperature to the lower end of said cell, and a plurality of air outlets leading from vertically spaced points of said cell.

6. A structure as specified in claim 5, said outlets being spaced around the wall of said cell.

7. An evaporating apparatus comprising a cell, a vertical hollow shaft in said cell carrying a centrifugal atomizer, a pipe for supplying liquid to the upper end of said hollow shaft, a valve for said pipe, a bowl on the upper end of said shaft, and a swinging wing for controlling said valve, said wing being located in said bowl, whereby a rotating body of liquid rising in said bowl will engage and actuate said wing to close said valve.

8. A structure as specified in claim 2, the bottom of said cell being below said jacket to provide a relatively cool collecting means for the product.

9. The method of evaporating liquid consisting in spraying the same into the upper end of a chamber while supplying hot air to the lower end of said chamber and air at a lower temperature to the upper end of said chamber, and at the same time permitting the air to escape at different elevations, whereby to produce the several air currents as set forth.

In testimony whereof I have hereunto set my hand.

SAMUEL M. DICK.