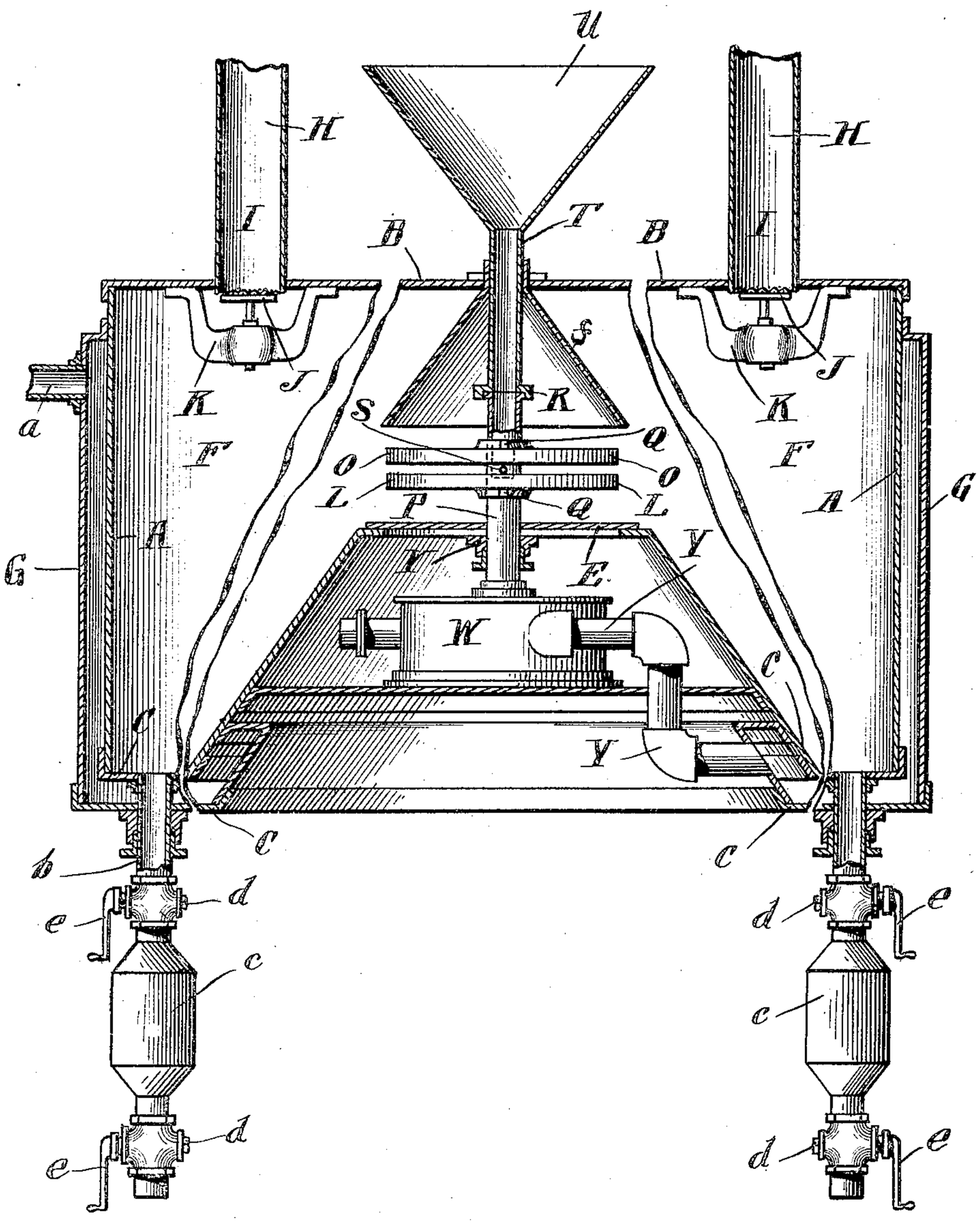
No. 888,018. PATENTED MAY 19, 1908.

J. A. JUST.

EVAPORATING APPARATUS.

APPLICATION FILED NOV. 24, 1906.



Attest:
S. D. Mitchell
A. L. O'Brien

Inventor:
John A. Just
by Dickerson, Brown, Raegener & Burney Attys.

UNITED STATES PATENT OFFICE.

JOHN A. JUST, OF SYRACUSE, NEW YORK

EVAPORATING APPARATUS.

No. 888,018. Specification of Letters Patent. Patented May 19, 1908.

Application filed November 24, 1906. Serial No. 344,899.

To all whom it may concern:

Be it known that I, JOHN A. JUST, a citizen of the United States, and resident of Syracuse, New York, have invented certain new and useful Improvements in Evaporating Apparatus, of which the following is a specification, accompanied by drawings.

This invention relates to improvements in evaporating apparatus for evaporating liquids, more particularly to centrifugal misting and evaporating apparatus, utilizing a vacuum for evaporating purposes.

The objects of the invention are to improve upon the construction of such apparatus and increase the efficiency whereby a liquid, as for instance milk, may be reduced to a dry powder or reduced to condensed form.

Further objects of the invention will hereinafter appear and to these ends the invention consists of evaporating apparatus for carrying out the above objects embodying the features of construction, combinations of elements, and arrangement of parts having the general mode of operation substantially as hereinafter fully described and claimed in this specification and shown in the accompanying drawings, in which the figure is a longitudinal elevation partly in section of apparatus embodying the invention.

Referring to the drawings, A represents the walls of a chamber, the top B and the bottom C of which are shown broken away as this chamber may be very large, even up to thirty or forty feet square. The size of the chamber in the practice is therefore very much larger in actual proportion to the remainder of the apparatus than as illustrated. The bottom C is preferably raised or projected inwardly in the form of a truncated cone having the sides D and top E so that the sides D of the cone and the walls A of the chamber form a chute or collecting space for the dry material.

The chamber which will be designated F is provided with a jacket G for steam or other heating fluid, and is also provided with the suction pipes H communicating with the chamber through the top B. Over the openings of the pipes H are provided fine screens I to aid in preventing the dried material from being carried off by the suction. In front of each screen I are placed revolving clearing blades J adapted to be rotated by motors of any suitable character carried by the brackets K and connected to the blades J. The revolving blades J also prevent the dried material, which may be in the form of a powder, from passing off through the suction pipes H.

Within the vacuum chamber F are arranged revolving plates L and O adapted to be revolved together in the same direction at a high speed, which may be from two thousand to eighteen thousand revolutions per minute. These disks may be of steel and are adjustably mounted on the shaft P by any suitable means, as for instance the set screws Q, whereby the distance between the inner surfaces of the plates may be adjusted as desired and normally the surfaces of the disks should almost touch. The shaft P extends upwardly to the collar R and the upper portion of the shaft is hollow as indicated in dotted lines. A fine aperture S, communicating with the hollow interior of the shaft, is provided between the inner surfaces of the plates L and O to permit the liquid material passing down through the inside of the shaft to pass out between the plates.

The collar or bearing R is carried by the stationary hollow shaft T, suitably supported from the top B of the chamber F and provided with a funnel U. The revolving shaft P which carries both the revolving plates is carried in a suitable bearing V in the plate E and is adapted to be driven by any suitable form of motor, as for instance the steam turbine W, provided with the intake X and the exhaust pipe Y; which communicates with the steam jacket G. The jacket is provided with an outlet *a*, and as shown, extends up around the sides of the vacuum chamber F and around the portion of the inner walls D of the chamber. At the lower portions of the chamber F are provided the outlets *b*, communicating with the receiving chambers *c*, which are of sufficient size to receive a substantially large quantity of the material. Above and below each receiving chamber *c* are provided the valves *d*, provided with suitable hand operating devices in the form of cranks *e* connected to the valve spindles. These valves *d* may be of any suitable character, preferably one-way valves, and by means of the arrangement of valves shown the material may be withdrawn from the vacuum chamber F without interfering with the normal working conditions of the chamber. When the upper valves *d* are opened the lower valves *d* are closed, and before the lower valves are opened, the upper valves should be closed,

thereby preventing communication of the chamber F with the outside air. Preferably a hood *f* is provided over the revolving disks L and O to prevent material from falling upon said disks.

According to the construction described, the liquid to be concentrated or dried passes out of the aperture or apertures S upon the lower revolving plate L, and is discharged from the periphery into the vacuum chamber F in a misted form, permeating substantially the entire chamber. Substantially as complete a vacuum as possible should be maintained in the chamber F. The heat of the chamber should be varied in accordance with the nature of the material being operated upon.

If liquid milk is being fed to the revolving plate L, the milk is discharged by centrifugal force into the chamber F in atomized form and evaporating moisture passes off through the suction pipes H, while the portion of the milk recovered collects in the lower part of the chamber F in the form of an extremely fine dry powder, which is received in the chambers *c*. When the disks L and O are adjusted very close together almost touching, the milk will be reduced to a dry powder, but if it is desired to obtain as a product condensed milk the plates L and O should be adjusted further apart and revolved at a lower speed, thereby permitting a larger quantity of milk to flow on to the plate L and issue from between the plates, in which latter case the milk will collect in the lower part of the chamber F in condensed form, which may be withdrawn into the receivers *c*. The extent to which the moisture of a given droplet of milk will be evaporated during its travel from the periphery of the rotating disk to the bottom of the chamber will depend very much on the size of this droplet. The size of the droplets in the mist can be readily regulated by adjusting conditions in the manner described. As long as the temperature of the chamber F and the speed of the plates and quantity of material fed are all maintained substantially constant, a substantially uniform product will be obtained, either as powdered milk or as condensed milk.

The inner surface of the chamber F may be lined with tin, or tinned steel or iron, which may be readily cleansed and sterilized. The chamber is preferably constructed without corners so that there will be no opportunity for stale products to lodge in the chamber, and consequently little labor is required to maintain the apparatus in a requisite condition to obtain a product free from extraneous contamination.

In order to successfully concentrate or reduce liquid milk either to a dry powder, or to the so-called condensed form, and in order to obtain a wholesome stable product with all the milk constituents in an unchanged condition, the full milk itself or the separated milk and cream added should be treated in such manner as to cause the cream or fatty portion of the milk to further emulsify with the albuminous portion and salts, in a much more complete emulsification or state of finer sub-division than exists in ordinary milk. This object is attained with the present apparatus. When this emulsification is accomplished and the product subjected to desiccation in the apparatus described, a condensed milk or dried product will be obtained, which will keep an indefinite time unchanged in a proper package. On redissolving the product with the requisite quantity of water fresh milk is formed, like that from which the product was made, without the use of any preserving agent whatever. When milk is sprayed in the comparatively coarse form of an ordinary spray into a more or less heated atmosphere in order to reduce it to dryness, the final result is different in many ways from that obtained in the operation of my apparatus. One serious fault of the products heretofore obtained by spraying is that the fat quickly becomes rancid and assumes an otherwise disagreeable odor.

By misting the liquid centrifugally at an extremely high speed as practiced in accordance with my process the dissociation of the various ingredients of the milk which occurs in spraying is prevented, and these ingredients are brought into most intimate subdivision contact and association. Ordinary spraying tends to dissociate, or change the state of physical aggregation of the ingredients of the milk so that the albuminous particles are covered with fat, when such sprayed particles are exposed to a heated atmosphere in the process of desiccation. Such a product will not keep and becomes rancid quickly, assuming a cheesy odor, so that for this reason full cream milk has never been successfully desiccated by the spraying process.

By misting the milk centrifugally in my apparatus, the product is rendered absolutely uniform and is greatly superior to the ordinary commercial products, and is produced at much less cost in a much shorter time than heretofore. Very large quantities of milk can thus be condensed or reduced to a dry powder in a short time. The condensation or reduction of the milk in my process is practically instantaneous and no time is afforded for harmful changes to occur in the milk solids, for all such harmful reactions require time. Milk as ordinarily condensed in a vacuum pan requires many hours of treatment, according to the capacity of the pan, five or more tons of milk being usually placed in these pans at one time and slowly condensed. In my process the milk is supplied in a continuous stream, and the completed product is continuously removed.

The full milk may be separated in an ordinary separator in order to first remove the coarser impurities and dirt generally met with in milk, and by this operation the cream will also be separated. The milk and cream may then be run through a suitable machine to unite and mix the two, the cream being added in proper proportion to the cleansed and separated milk. This mixed milk is then fed into my machine, and is thereby atomized and its constituents brought into intimate contact, infinitely more intimate than existed in the fresh milk. This intimate contact produces a smooth and wholesome article of condensed milk or dry milk powder. If the impurities were not first removed they would concentrate as the milk concentrates and would become more objectionable and pronounced in the finished product, but these impurities are chiefly removed with the dirt or heavy dirt particles. The dirt of milk consists of porous spongy matter, which is teeming with a low order of bacteria, and hence my products are especially free from anaërobic and harmful germs.

The condensed milk product may be sweetened or it may be condensed unsweetened as desired. Milk condensed in the ordinary way in a vacuum pan, on standing, or in a store, often cakes more or less and a portion of the product solidifies to a crystalline mass. Milk condensed by my process will not separate its crystalline portion from the other ingredients. The dry powder obtained by my process is very uniform, owing to the initial uniformity created in the milk before reducing it to the condensed form or dry powder. The fat globules, which are seen under the microscope fairly far apart and of varying sizes, will be small and very close to each other after the first treatment or additional emulsification. This intimate emulsification once secured will yield a condensed milk or milk powder, giving when mixed with a requisite amount of water for restoring the product, a liquid milk which will hold its fat uniformly throughout, unlike other milk products in which the fat will rise to the surface when the product is mixed with water.

I claim and desire to obtain by Letters Patent the following:

1. In evaporating apparatus, the combination of a chamber, means for heating the same, flat-faced centrifugal disks arranged close together face to face in said chamber, means for rotating the disks together in the same direction, and means for supplying liquid between said disks at or near their center.

2. In evaporating apparatus, the combination of a chamber, means for heating the same, means for producing a partial vacuum therein, flat-faced centrifugal disks arranged close together face to face in said chamber, means for rotating the disks together in the same direction, and means for supplying liquid between said disks at or near their center.

3. In evaporating apparatus, the combination of a chamber, means for heating the same, means for producing a partial vacuum therein, means for removing material without changing the vacuum, flat-faced centrifugal disks arranged close together face to face in said chamber, means for rotating the disks together in the same direction, and means for supplying liquid between said disks at or near their center.

4. In an apparatus adapted to treat milk, the combination of a chamber adapted to receive and collect misted material, imperforate centrifugal disks having parallel faces and arranged close together face to face in said chamber, means for rotating the disks together in the same direction and means for supplying liquid between said disks at or near their center.

5. In evaporating apparatus, the combination with a vacuum chamber of a vertical, rotatable shaft, a pair of flat-faced centrifugal disks arranged face to face and close together on said shaft within the chamber and rotatable with said shaft, and means for supplying liquid to be condensed between said disks at or near their center.

6. In drying apparatus, the combination with a vacuum chamber, a vertical rotatable shaft, a pair of flat-faced centrifugal disks within the chamber and adjustably mounted on said shaft face to face and close together and means for supplying liquid to be condensed between said disks at or near their center.

7. In evaporating apparatus, the combination with a vacuum chamber of one or more suction pipes connected thereto, screens over the inner end of said one or more pipes, revoluble blades mounted to revolve in front of said screens and a centrifugal device in said chamber.

8. In evaporating apparatus, the combination of a substantially large closed chamber, a vertical shaft, a pair of centrifugal disks mounted upon said shaft to revolve therewith, said disks having smooth, flat opposed surfaces arranged close together, means for continuously supplying liquid to the surface between said disks, means for withdrawing condensed material from said chamber, means for producing and maintaining a partial vacuum in said chamber and means for heating the chamber.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

JOHN A. JUST.

Witnesses:
OLIN A. FOSTER,
A. L. O'BRIEN.