W. S. OSBORNE.

DESICCATING APPARATUS.

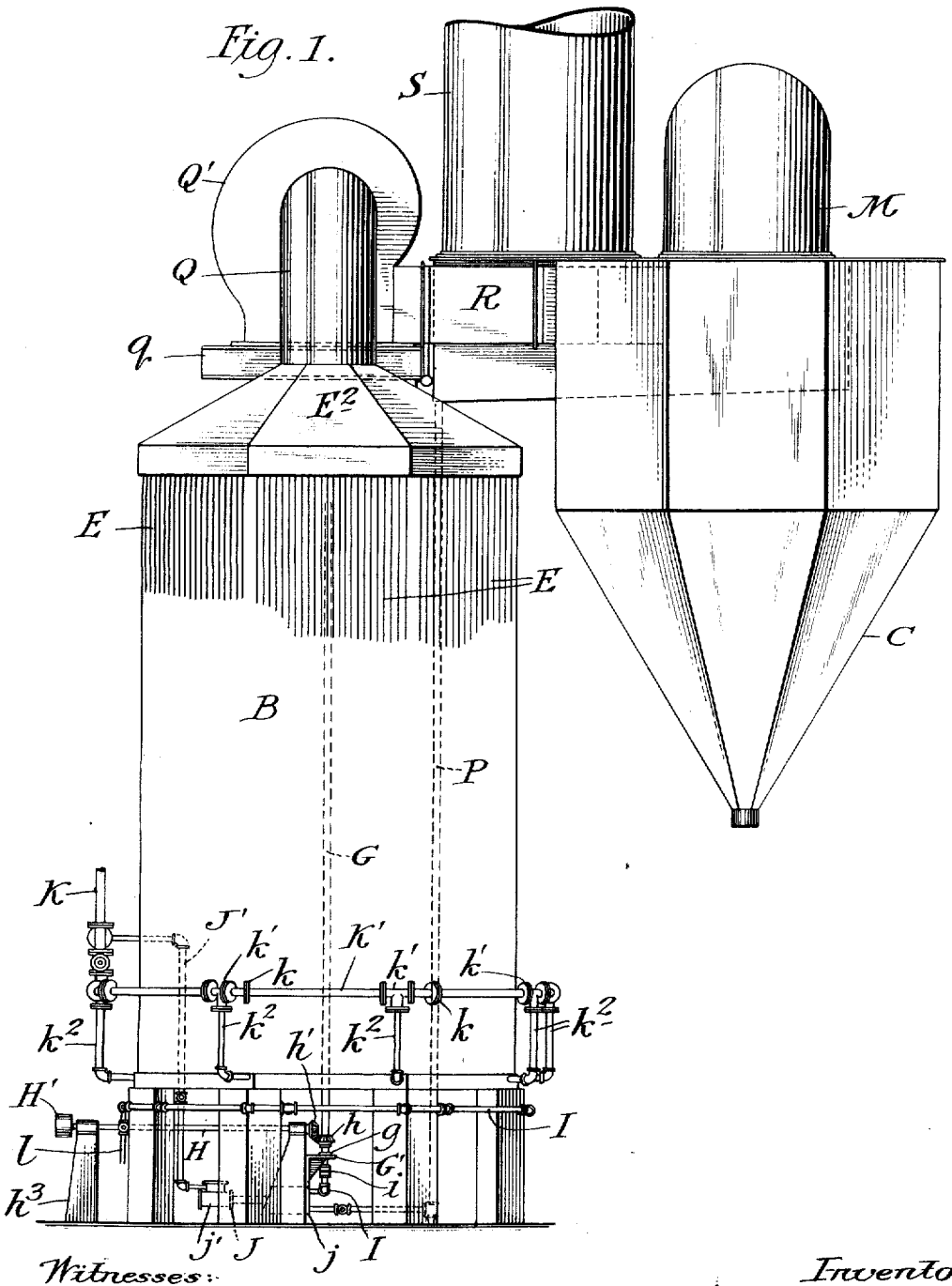
APPLICATION FILED FEB. 16, 1910.

1,011,993.

Patented Dec. 19, 1911.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

A. R. Appleman

M. C. Powell

Inventor:

William S. Osborne.

By Griffin & Bernhard

Attys.

W. S. OSBORNE.

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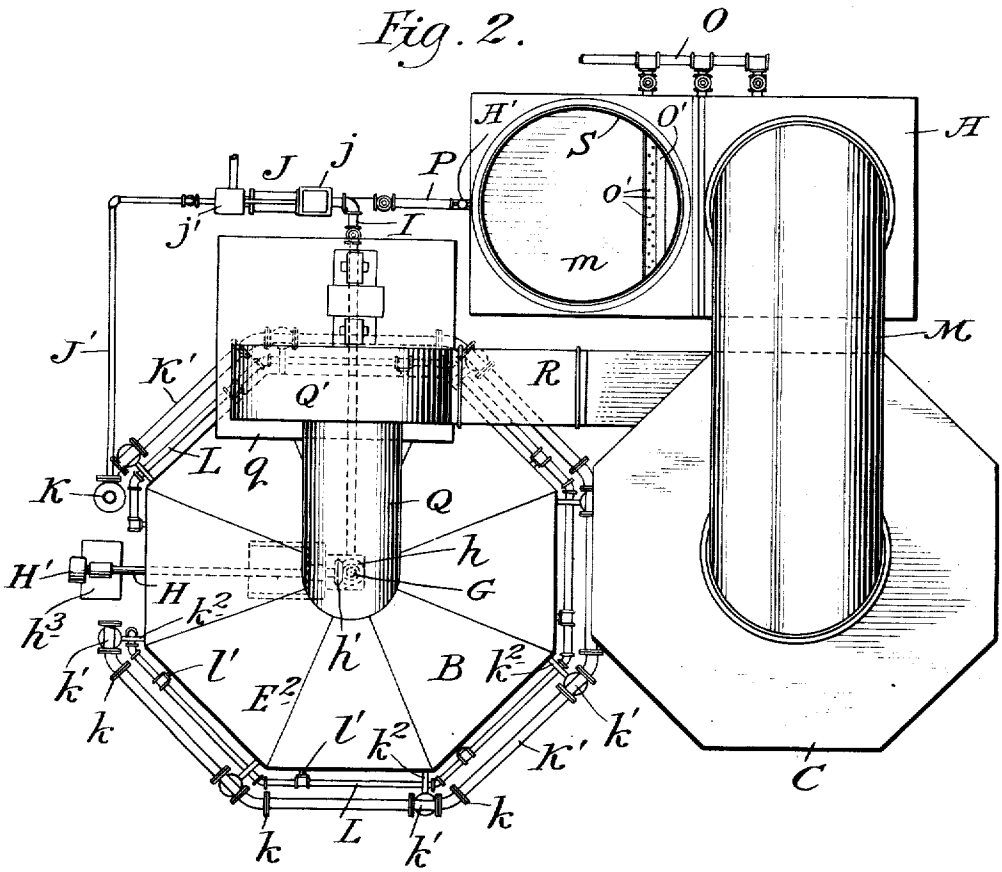
5 SHEETS—SHEET 2.

Fig. 2.



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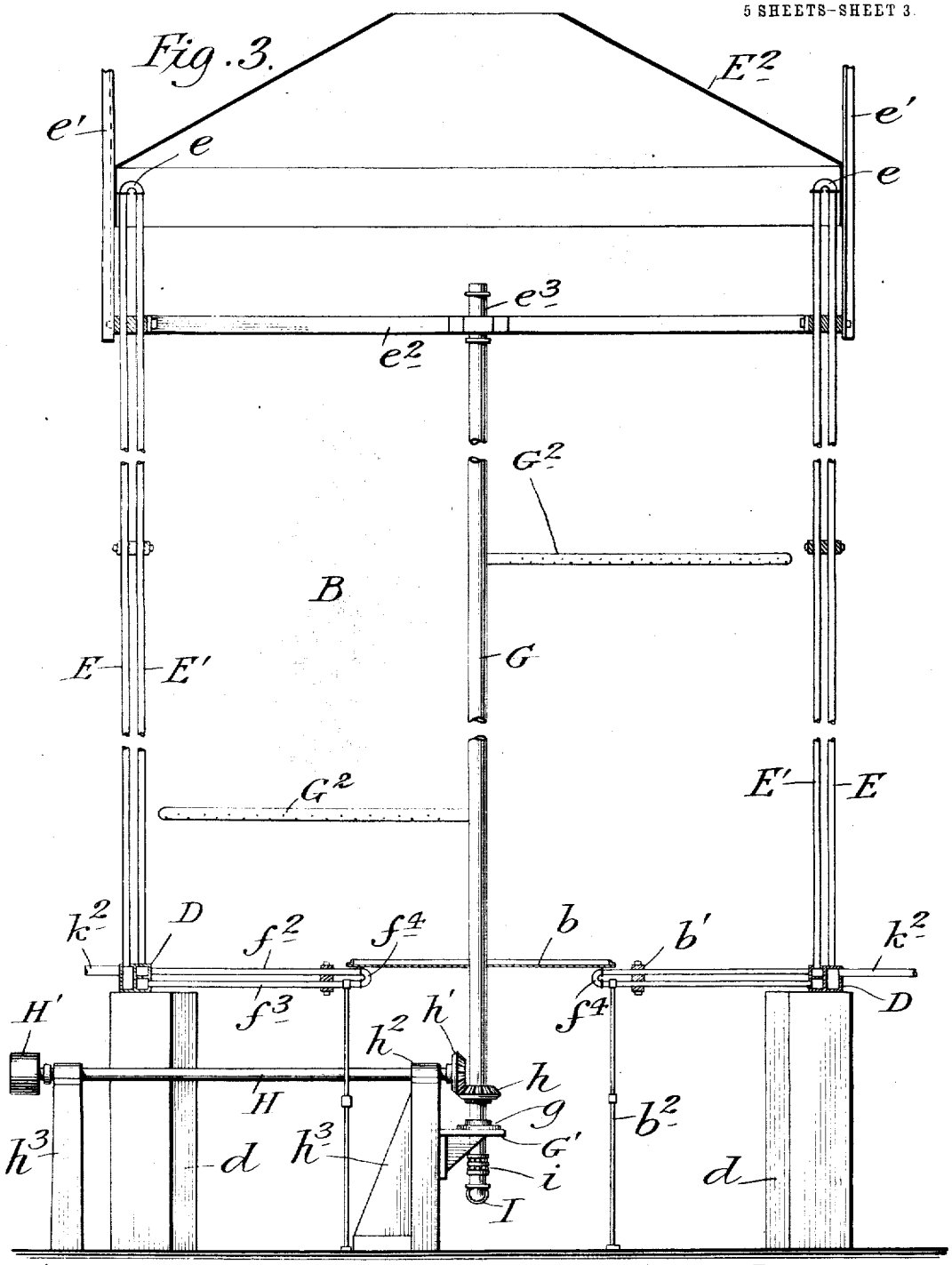
5 SHEETS-SHEET 3.

Fig. 3.



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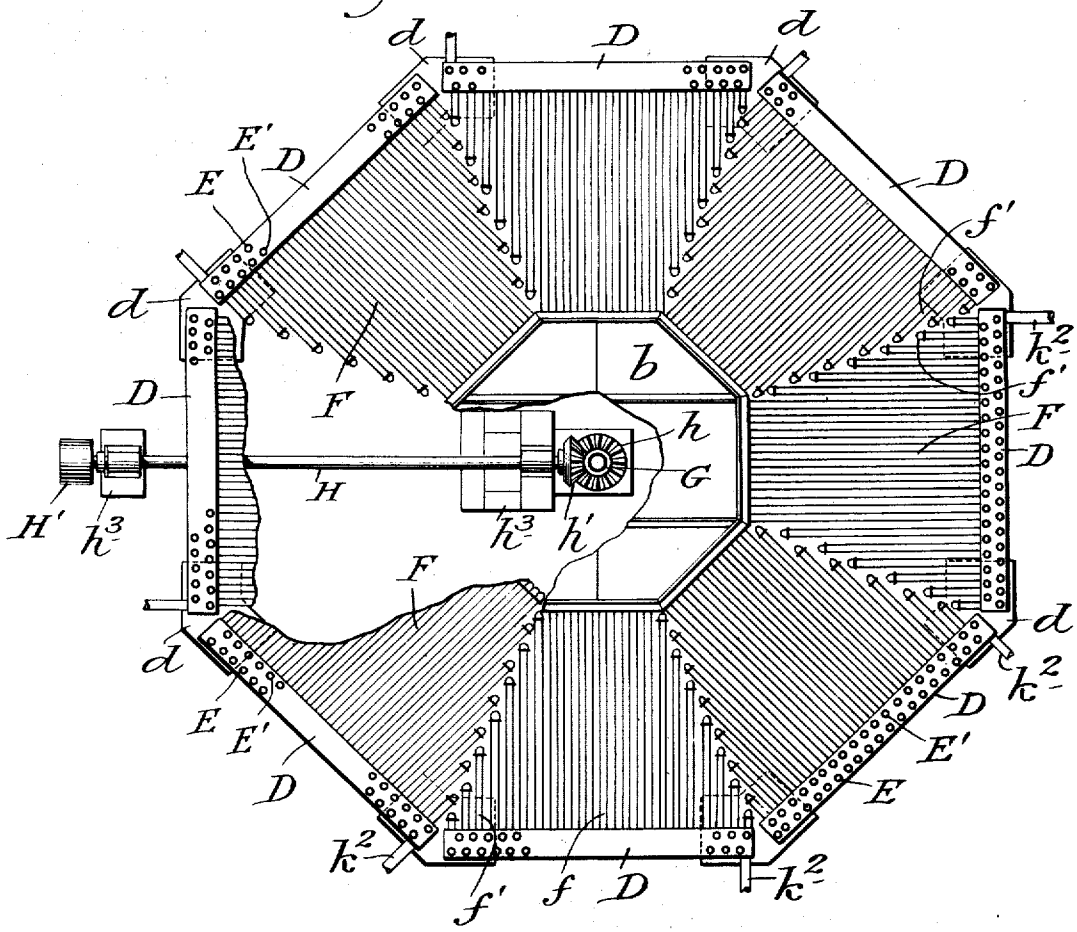
5 SHEETS SHEET 4

Fig. 4.



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M. C. Powell

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5 SHEETS—SHEET 5.

Fig. 5.

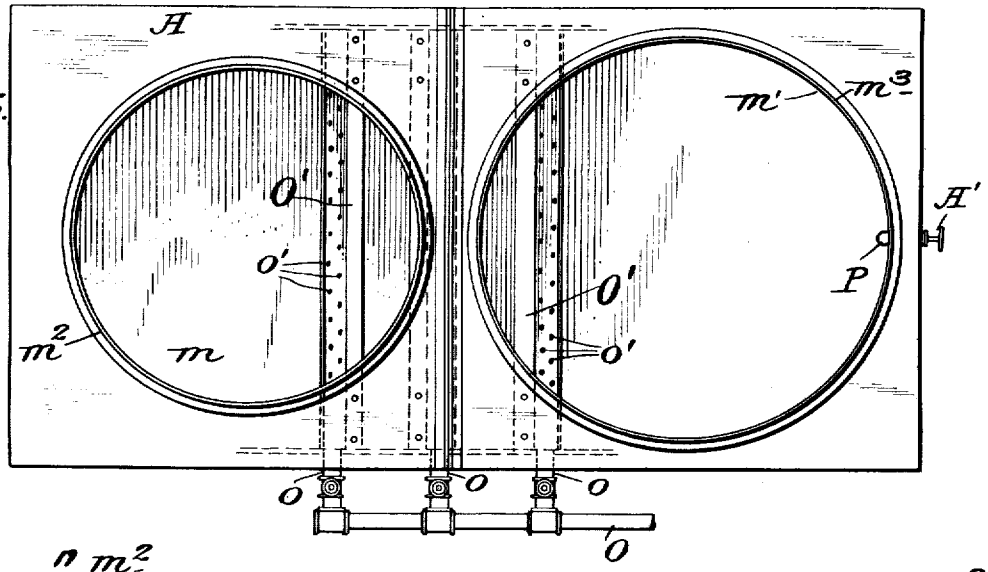


Fig. 6.

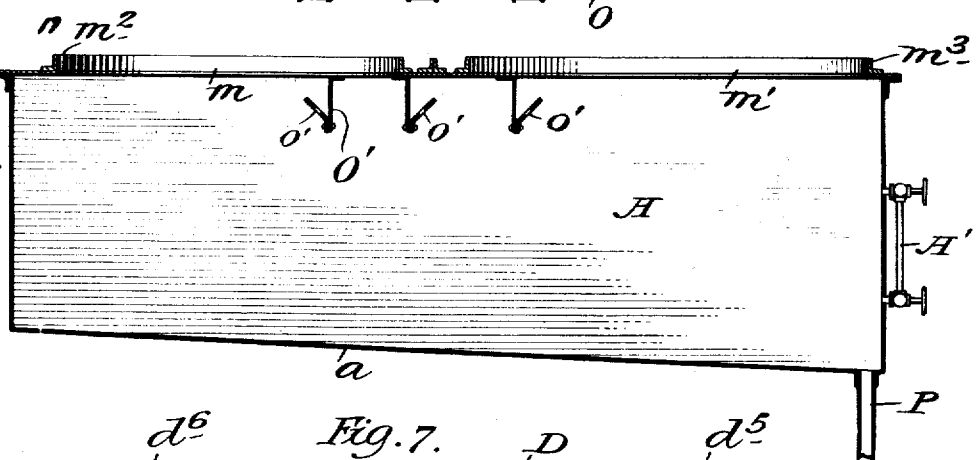


Fig. 7.

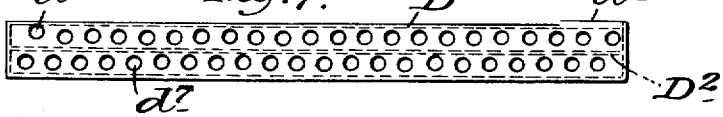


Fig. 8.

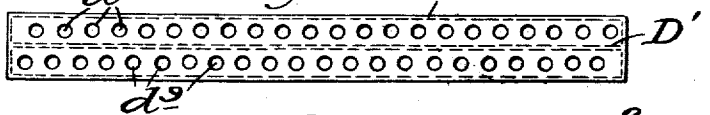


Fig. 10.

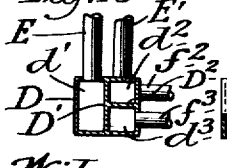
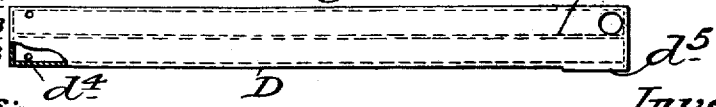


Fig. 9.



Witnesses:-

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M. C. Powell

Inventor.

William S. Osborne.

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Attys.

UNITED STATES PATENT OFFICE.

WILLIAM S. OSBORNE, OF NEW YORK, N. Y., ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO OSBORNE DESICCATING MACHINERY COMPANY, A CORPORATION OF NEW YORK.

DESICCATING APPARATUS.

1,011,993. Specification of Letters Patent. Patented Dec. 19, 1911.

Application filed February 16, 1910. Serial No. 544,177.

To all whom it may concern:

Be it known that I, WILLIAM S. OSBORNE, a citizen of the United States, residing in the city of New York, borough of Manhattan, county and State of New York, have invented a certain new and useful Desiccating Apparatus, of which the following is a specification.

This invention is an apparatus for desiccating liquid substances in general, such as milk in its various forms, blood, etc., the object being to obtain the edible or other constituents of such substances in a dry and, preferably, powdered form. The apparatus enables the dehydrating operation to be carried out expeditiously and economically, and the resultant dried products are of superior quality.

The invention embodies novel means for bringing the liquid products in contact with air to effect their dehydration, and means for subsequently depriving the air from residual particles contained therein.

If desired, the air may be deprived, in whole or in part, of the moisture which it carries, as *e. g.*, by refrigerating or cooling said air prior to heating it. For the purpose of illustrating the manner of operating the apparatus it will be assumed that the liquid to be dehydrated is milk.

In a broad aspect, the apparatus embodies a structure wherein the liquid under treatment is distributed in thin streams, preferably by gravity and centrifugal force, and subjected to the action of heated air currents flowing toward and around said streams, whereby the milk is dehydrated while in a suspended condition, the air becoming laden with the dried particles of milk. The air carrying the milk particles is then introduced into a separator wherein said dried particles are separated and deposited in the form of a dry powder. The air escaping from the separator carries a small percentage of very fine milk particles, and the present invention embodies a method and means for completely recovering all of such particles. This method, broadly speaking, consists in causing said air to flow across and through descending streams of liquid, whereby the latter absorbs the residuary particles.

In the accompanying drawings I have illustrated one practical embodiment of the invention, but the construction shown therein is to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is an elvation of an apparatus for carrying out my process for dehydrating food and other substances. Fig. 2 is a plan view thereof. Fig. 3 is a vertical section, on an enlarged scale as compared with Figs. 1 and 2, of the chamber into which the substance to be treated is distributed and through which air heated to the proper temperature is adapted to circulate in large quantities. Fig. 4 is a plan view illustrating the construction of the air heating appliances at the base of the treating chamber illustrated in Fig. 3. Figs. 5 and 6 are, respectively, a plan view and a longitudinal section of a milk supply and recovery tank. Figs. 7, 8, 9 and 10 are detail views of one steam supply header used in connection with the vertical air heating coils at a side of the treating chamber, and other horizontal air heating coils forming a part of the grated bottom of said treating chamber.

The desiccating apparatus of this invention, adapted to carry out the novel process of desiccating liquid substances and collecting solid matters therefrom, embodies a supply tank, A, a liquid treating chamber, B, and a collector or separating device, C, as shown in Figs. 1 and 2 of the drawings. The collector or separating device, C, may be of the usual or any preferred style of pneumatic separators, such as disclosed in certain prior patents heretofore granted to me, but the detailed construction of the desiccating chamber, B, and of supply tank, A, will be hereinafter described in detail.

Referring now to the liquid treating apparatus embodying generally the liquid treating chamber, B, shown more particularly in Figs. 1, 2, 3 and 4 of the drawings, D designates a series of headers arranged in horizontal positions at the base portion of chamber, B. As shown more particularly in Fig. 4, the headers are at an angle to each other 30 as to form a substantially octagonal base. The headers are supported on a foundation herein shown as a series of pillars, *d*. Each header is, preferably, a metallic box, and it may be composed of cast metal or pressed plate metal. One of the headers is shown in detail in Figs. 7, 8, 9, and 10, by reference to which it will be seen that each header is provided with a longitudinal ver-

tical partition, D′, and with a horizontal longitudinal partition, D^2. The vertical partition, D′, divides the header interiorly into a longitudinal feed chamber, d', whereas the partition, D^2, divides the header into compartments, d^2, d^3, shown more clearly in Fig. 10. At one end of the vertical partition, D′, is provided an opening, d^4, which enables the water of condensation to be drained from the header, but at the other end of said header it is tapped to provide an opening, d^5, adapted for the attachment of a steam feed pipe, hereinafter referred to. The top wall of each header is tapped with a series of openings, d^6, d^7, and the inside wall of said header is tapped with other openings, d^8, d^9, whereby the air heating coils are adapted to be attached to the header.

The side walls of chamber, B, are formed by groups of air heating coils, the coils of each group being indicated at E, E′. The vertical coils composing one group are attached to one of the headers, and the several groups of vertical coils are positioned at an angle one to the other, and extend upwardly from the headers for suitable distances, whereby the groups of coils form the walls of liquid treating chamber, B, the latter being substantially octagonal in cross section. The member, E, of each vertical coil is screw threaded at its lower end in order that it may be inserted into opening, d^6, of the header. The other member, E′, of each coil is threaded at its lower end so as to be screwed into the tapped opening, d^7, of the header, and the upper ends of said pipes or members, E, E′, are united by a return elbow, e, whereby steam may circulate upwardly in pipe, E, and flow through elbow, e, into and downwardly through pipe, E′, the steam being supplied to pipe, E, from chamber, d', and flowing through pipe, E′, into chamber, d^2, of the header. The groups of vertical coils, E′, extend for suitable distances above headers, D, and the upper ends or return bends of said vertical coils are in coöperative relation to a hood, E^2, the latter being supported or stayed by vertical members, e'. Across the lower part of the hood extends one or more supporting and bracing rails, e^2, and at the middle of chamber, B, said rail or rails are equipped with a bearing, e^3, for the upper part of a rotatable vertical milk distributing pipe, G, to be hereinafter described.

The bottom of chamber, B, is formed by groups of horizontal air heating coils, F, see Figs. 3 and 4. The coils of each group vary in length, the longer tubes, f, being at the middle of the group and the shorter tubes, f', being at the respective sides of the group. The tubes of each coil, f^2, f^3, are disposed one above the other, and connected at their inner ends by elbow, f^4, see Fig. 3, and said tubes, f^2, f^3, are connected to the inner side of one of the headers so as to communicate with compartments, d^2, d^3, of said header, said pipes, f^2, f^3, being attached to the header on opposite sides of the horizontal partition, D^2, in said header. Each group of coils, F, occupies a substantially horizontal position so that the short side tubes, f', of one group is adjacent to the corresponding short side tubes, f', of the other group, see Fig. 4, whereby the groups of horizontal coils are disposed compactly with relation to each other so as to form a grated bottom for chamber, B. The steam circulating through the vertical coils of one group is delivered into chamber, d^2, of the header, from whence the steam passes through upper horizontal tube, f^2, the elbow or bend, f^4, the lower horizontal tube, f^3, back into chamber, d^3, of the header, and thus the steam is adapted to circulate through chamber, d', of the header, upwardly and downwardly through the vertical coils of one group, into chamber, d^2, and thence in and out through the respective tubes of the horizontal coils, back into chamber, d^3, whereby continuous circulation of the steam is secured through the header, the vertical coils and the horizontal coils constituting one complement of the air heating devices for liquid treating chamber, B.

At the base of chamber, B, is provided a central plate, b, the edge portion of which engages with and covers the inner ends of horizontal coils, F, and if desired, said inner ends of the coils may be connected, as at b', and held in position by tension rods, b^2. The central plate is provided with an aperture through which passes the liquid distributing tube, G, the upper end of which is supported in bearing, e^3. Said vertical distributing tube is supported near its lower bracket, G′. A bevel gear, h, is fixed to the vertical distributing tube, preferably at a point above said step bearing, g, said bevel gear meshing with a similar gear, h', on a driving shaft, H. Said shaft is supported in bearings, h^2, of the bearing posts, h^3, and to the shaft, H, is fixed a pulley, H′, adapted to be engaged by a belt which drives shaft, H, and vertical distributing tube, G. A liquid supply pipe, I, is operatively connected by a swivel coupling, i, with distributing pipe, G, at a point below step bearing, g, and said pipe, I, leads from a liquid cylinder, j, of a pump, J, the steam cylinder, j', of which pump is adapted to be supplied with steam through a branch pipe, J′.

Live steam is supplied to the heating coils of the treating chamber from a main pipe, K, which is coupled in a suitable way with a substantially annular pipe, K′, the latter occupying a horizontal position outside of the vertical coils, E, E′, and extending prac-

tically around the desiccating chamber. Horizontal pipe, K′, is composed of sections at an angle to each other and coupled together at k, and each section of said horizontal pipe, K′, is provided with a T, k', to which is attached a branch pipe k^2. A number of these branch pipes, k^2, are employed, and each branch pipe it attached to one of the headers, D, at d^5. It will be seen that the steam supplied by pipe, K, is carried around the desiccating chamber by horizontal pipe, K′, the latter pipe operating to supply steam under uniform pressure to the branches, k^2, and said branches operating to supply steam to chan bers, d', of headers, D, thus insuring uniform distribution of the steam to the headers, from whence it flows through the vertical coils and horizontal coils successively. To provide for the exit of the water of condensation which accumulates in the coils and the headers, I provide a drain pipe, L, positioned around the foundation of the desiccating chamber and at a suitable distance below steam pipe, K′. The drain pipe, L, is composed of sections coupled together in about the same way as steam pipe, K′, and this drain pipe is connected by branch pipe, l', with the headers at d^4, so as to allow the water of condensation to flow by gravity from the headers into the drain pipe, said drain pipe having a suitable trap, l, to preclude the escape of steam through said pipe.

Referring now to supply tank, A, shown in Figs. 2, 5 and 6 of the drawings, said tank is composed, preferably, of sheet metal united in any desired way. The tank is provided with bottom, a, which inclines from one end of the tank toward the other end, thus providing for the gravity flow of liquid toward the deeper end. The tank is equipped with a liquid gage, A′, which indicates the height of the body of liquid therein. The tank is provided in its top with two openings, m, m', the latter being of greater diameter than the opening m. Around the opening, m, is provided a flange, m^2, to which is connected one end of a wind trunk, M, which leads from separator or collector, C. The larger opening, m', of the tank is provided with a flange, m^3, and this opening constitutes the outlet for the current of air which is supplied to the tank by the wind trunk from the separator or collector.

The liquid to be treated is supplied from any suitable source to tank, A, by appropriate means, the latter being herein shown as a feed pipe, O, positioned along one side of the tank, see Fig. 5. From this feed pipe extends a number of branch pipes, o, which are positioned horizontally within the tank and across its chamber, preferably below the top of said tank. Two of said pipes, o, may extend across the openings, m, m', and they may be provided with perforations so as to deliver the liquid in thin streams into the tank, but it is preferred to employ a plurality of distributing troughs, O′, shown in Fig. 6. Said troughs extend across the tank, and they are provided with openings, o'. The branches, o, of the feed pipe discharge into the troughs, and these troughs discharge the liquid through their openings, o', whereby the liquid is delivered in thin streams into the trough and in the path of the air current which flows from opening, m, below the top of the tank, and makes its exit through opening, m'. The purpose of this construction and arrangement is to cause the air escaping from collector, C, to flow through supply tank, A, in a manner for the air to pass through a series of streams of liquid, whereby the fine dried particles which are carried by the air current from the collector will be caught in the streams of liquid distributed by troughs, O′, thus recovering the fine dried particles and causing them to be returned into the liquid of the tank, wherein said particles are dissolved, thereby securing economy in the treatment of the material.

Liquid is drawn from the bottom portion of tank, A, by pump, J, through a connecting pipe, P, and when the pump is operated by steam supplied through pipe, J′, the liquid is drawn from said tank and forced through pipe, I, into the vertical distributing pipe, G, the latter being provided with a series of radially positioned tubular arms or members, G^2, whereby the liquid is delivered in thin streams within the treating chamber, B.

To the upper end of hood, E^2, is attached a wind trunk, Q, which leads to a suction fan, blower or exhauster, Q′, erected on an elevated fan platform, q, suitably supported above, or adjacent to, the desiccating chamber. From the suction fan extends a wind trunk, R, which leads to collector or separator, C, to which said wind trunk, R, is connected tangentially, for the purpose of discharging the air current into the separator in a way to set up a whirling or cyclonic motion of the air, so that the separator will operate in the well known way to precipitate the heavier dried particles of material, thus eliminating them from the air current. To the flange, m^3, of supply tank, A, is attached an off bearing wind trunk, S, adapted to convey the moist current of air away from the desiccating apparatus to a suitable place of discharge.

It should be remarked that the suction fan, Q′, is provided with a blast gate as is usual, and the capacity of the fan for inducing a current through the desiccating chamber is regulated by adjusting the blast gate and by driving said fan at a speed which is to be determined in all cases by experimentation, with a view to securing a

current of air of such pressure and speed as will take up the dried particles resulting from the treatment of the liquid material, and which at the same time will preclude drops or streams of liquid material from coming into contact with the heated surfaces of coils, E, E′, and F, which coils constitute the wall and bottom of the desiccating chamber. Furthermore, the groups of vertical and horizontal air heating coils are so positioned and constructed that they provide spaces between the members of said coils, which spaces constitute the air inlets to the treating chamber. The area of the air inlets thus provided in the walls and bottom of the chamber should be equal to the capacity of fan, Q′, to exhaust the air from said treating chamber, but should it be found necessary in the operation of the apparatus to increase the volume of air admitted to the chamber, and also to increase the strength of the current flowing through the chamber, the blast gate should be opened still further and the speed of the fan increased until it is found that the current is of sufficient strength to preclude the particles of liquid matter from dropping into contact with the heating coils, F, at the bottom of the chamber, and with the heating coils, E, E′, at the sides of the chamber. It will be observed that in my apparatus the side walls of the treating chamber, as well as the bottom thereof, are formed by steam heated coils, and that the liquid is supplied under pressure to distributing pipe, G, by pump, J. Provision is thus made for the inlet of air at the sides of the chamber as well as at the bottom thereof, and this secures cross currents of air at the several sides and bottom of the chamber, whereby the liquid forced under pressure into the distributing pipe is precluded from being thrown by the rotary motion of the pipe into contact with the side walls formed by coils, E, E′, as well as from coming into contact with the bottom of the chamber formed by heating coils, F.

The operation may be described as follows:—The liquid to be treated is supplied to tank, A, from any suitable source through pipe, O. Steam under pressure is supplied by pipe, K, and distributed by pipe, K′, into the several headers of the vertical and horizontal coils, and at the same time the steam flows through pipe, J′, into the steam cylinder of pump, J. When the pump is in operation, liquid is drawn from tank, A, and supplied under pressure into pipe, G, the latter being rotated by shaft, H. Suction fan, Q′, having been set in motion, atmospheric air or dehydrated air from a suitable source is drawn through the spaces between coils, F, at the bottom of the chamber and coils, E, E′, at the sides of the chamber, thus establishing the cross currents of air adapted to flow toward that part of the chamber in which the liquid is being distributed by members, G^2, of pipe, G. The liquid matter supplied to treating chamber, B, is at once caught up by the currents of air flowing through said chamber, whereby the watery matter of the liquid substance is at once absorbed by the large volume of heated air flowing through the chamber. The dried particles resulting from the elimination of the watery matter are carried by the air current from treating chamber, B, into and through the fan, Q′, and thence delivered into the collector or separator, C. The heavier particles of dried matter are precipitated by the action of the air current within said collector or separator so that these heavier particles will remain in the collector and be delivered therefrom in the ordinary way. The air current escapes from the collector through wind trunk, M, which conveys it through opening, m, of tank, A, thus causing the air current to pass through the tank and through the streams of liquid matter which flow from the troughs, O′, within said tank. The effect of the air current flowing through the tank and through the streams of liquid matter supplied thereto is to catch the fine or minute particles of dried matter which are carried by the air current from the collector, and thus this dried fine matter or impalpable powder is recovered from the air current and dissolved in the liquid contents of the tank. The air current escapes through opening, m', and the off bearing wind trunk, S. The operations of supplying liquid matter to the tank, and of pumping said liquid matter from said tank back into the distributing pipe are carried on without interruption so that the process is a continuous one, and this process is economical in many respects, for the reason that the dried matter is not permitted to come into contact with heated surfaces of the treating chamber, and, furthermore, the dried substance, which would have a tendency to escape in the form of impalpable powder, is recovered in the supply tank and is again dissolved in the liquid contents thereof.

Having thus fully described the invention, what I claim as new, and desire to secure by Letters Patent is:

1. In a desiccating apparatus, a desiccating chamber, the side walls of which consist of air heating coils through which a heating medium is adapted to circulate, and means for drawing a blast of air through the spaces between said coils constituting the walls of said chamber.

2. In a desiccating apparatus, a desiccating chamber the side walls and bottom of which consist of air heating coils through which a heating medium is adapted to circulate, and means for drawing a blast of

air through the spaces of the coils which make up the walls and bottom of said chamber.

3. In a desiccating apparatus, a desiccating chamber the side walls and bottom of which consist of air heating coils through which a heating medium is adapted to circulate, means for drawing a blast of air through the spaces between the coils which make up the walls and bottom of said chamber, and a rotary liquid distributer positioned within said chamber.

4. In a desiccating apparatus, a desiccating chamber having a perforated bottom composed of a plurality of air heating coils through which a heating medium is adapted to circulate, and means for drawing a blast of air upwardly through the spaces between the heating coils which make up said bottom.

5. In a desiccating apparatus, a desiccating chamber, a device wherein the separation of solid particles from an air current is effected by a vortex and centrifugal action, a supply tank, and means connected with said tank for distributing a liquid spray within said chamber, said separating device being connected with the supply tank whereby the air current from the separating device is introduced into the supply tank.

6. In a desiccating apparatus, a device wherein the separation of dried particles from a current of air is effected by a vortex and centrifugal action, a liquid supply tank, means for leading the air from the separating means to said tank, and means for spraying liquid within said tank for separating the residual dried particles carried by the air current.

7. In a desiccating apparatus, a desiccating chamber the walls of which are formed by groups of air heating coils through which a heating medium is adapted to circulate, a header connected with the coils of each group, means for supplying steam to each of said headers, and means for drawing a blast of air through the spaces between the heating coils which make up the walls of said chamber.

8. In a desiccating apparatus, a desiccating chamber the walls of which consist of air heating coils arranged in groups and through which steam is adapted to circulate, a series of headers each having its chamber divided into compartments with which communicate the feed and return members of each group of coils, means for supplying steam to each of said headers, and means for drawing a blast of air through the spaces between the heating coils which make up the walls of said chamber.

9. In a desiccating apparatus, a series of headers each having a divided chamber, groups of air heating coils positioned to form the walls of a desiccating chamber and through which coils and the headers steam is adapted to circulate, the coils composing each group being connected with the respective compartments of one of said chambered headers, a steam supply pipe, branches each conneoting one of said headers with said steam supply pipe, and means for drawing a blast of air through the spaces between the heating coils which make up the walls of said chamber.

10. In a desiccating apparatus, a series of chambered headers, groups of air heating coils through which steam is adapted to circulate and said coils positioned to form the walls of a desiccating chamber, the coils of each group being connected to one of said headers, means for supplying steam to the headers, means connected with said headers for the escape of the water of condensation, and means for drawing a blast of air through the spaces between the heating coils which make up the walls of said chamber.

11. In a desiccating apparatus, a series of headers, groups of air heating coils through which steam is adapted to circulate, said coils being positioned to form the walls of a desiccating chamber, means for supplying steam to said headers, and means for drawing a blast of air through the spaces between the heating coils which make up the walls of said chamber.

12. In a desiccating apparatus, a series of headers, groups of vertical coils through which steam is adapted to circulate, said coils being positioned to form the walls of a desiccating chamber, each group of coils being connected to one of the headers, groups of coils positioned transversely to said chamber and forming the bottom thereof, each of said last mentioned groups of coils being connected to one of the headers, means for supplying steam to said headers, and means for drawing a blast of air through the spaces between the heating coils which make up the walls and the bottom of said chamber.

13. In a desiccating apparatus, a desiccating chamber the walls and bottom of which are composed of air heating coils through which a heating medium is adapted to circulate, means for supplying steam to said coils, a vertical liquid pipe positioned within said chamber, said pipe having means for distributing the liquid within said chamber, means for rotating the pipe, and means for drawing a blast of air through the spaces between said coils and said desiccating chamber.

14. In a desiccating apparatus, a desiccating chamber, a structure wherein the separation of dried particles from an air current is effected by a vortex and centrifugal action, means for producing a current of air through said desiccating chamber and delivering the current, laden with dried parti-

cles, into said centrifugal separating structure, whereby the heavier dried particles are precipitated and eliminated from the air current, a supply tank, means connecting the centrifugal separating structure with the supply tank, so that the minute dried particles carried with the air escaping from said centrifugal separating structure will be delivered into the supply tank, and means positioned within the tank for spraying liquid therein to effect the precipitation of said minute dried particles into liquid contained in said tank.

15. In a desiccating apparatus, a desiccating chamber, a structure wherein the separation of dried particles from an air current is effected by a vortex and centrifugal action, a fan or blower intermediate said chamber and the centrifugal separator, a liquid supply tank, means whereby liquid in the tank may be supplied to the desiccating chamber, a liquid spray means within the tank and positioned therein intermediate an air inlet and an air outlet, and a wind trunk leading from the centrifugal separator to the air inlet of said tank for discharging thereto a current of air laden with more or less minute dried particles from the centrifugal separator.

16. In a desiccating apparatus, a desiccating chamber the bottom and side walls of which are of a foraminous structure through which a heating medium is adapted to circulate, means for drawing a blast of air through the foraminous structure comprising the walls of said chamber, and means for distributing liquid within said chamber and in contact with the inflowing air currents, whereby the liquid is dehydrated while in a suspended condition.

17. In a desiccating apparatus, a supply tank provided with means for spraying a liquid therein, and means for bringing a current of air carrying dried particles into contact with said liquid spray.

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

WILLIAM S. OSBORNE.

Witnesses:
H. I. BERNHARD,
M. C. POWELL.