No. 765,315. PATENTED JULY 19, 1904.

J. A. JUST.

EVAPORATING APPARATUS.

APPLICATION FILED AUG. 31, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.

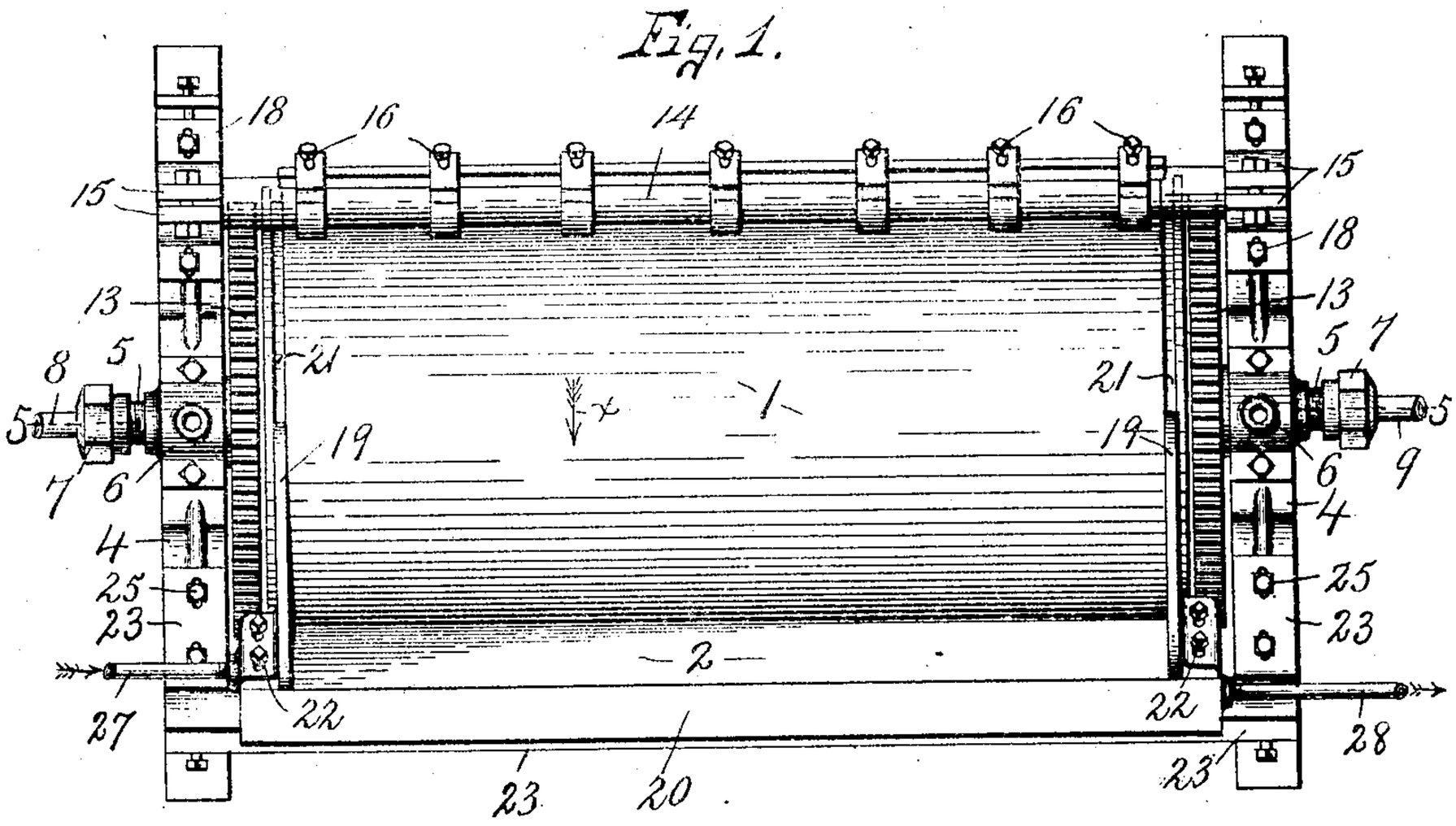
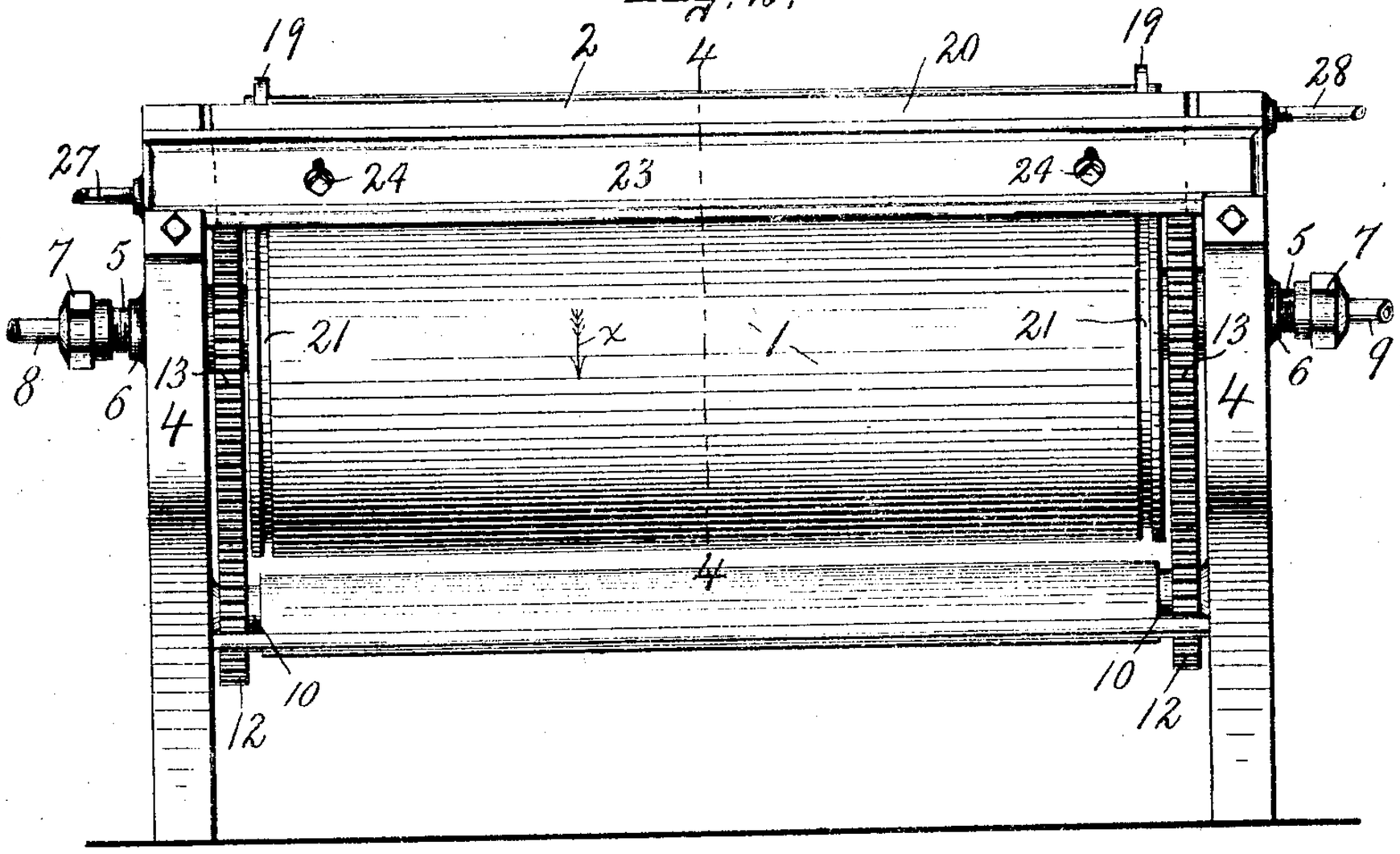


Fig. 2.



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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 3.

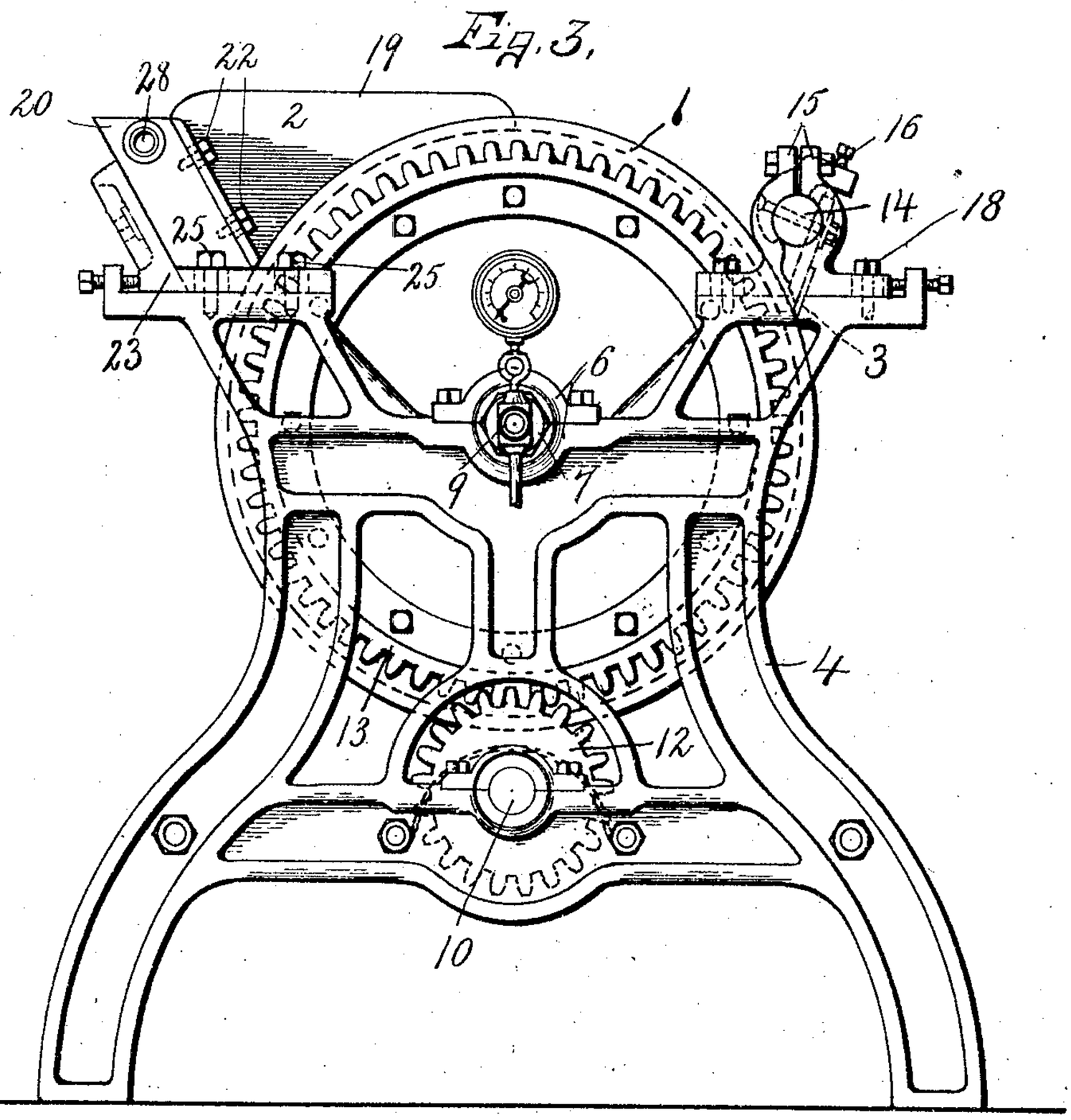
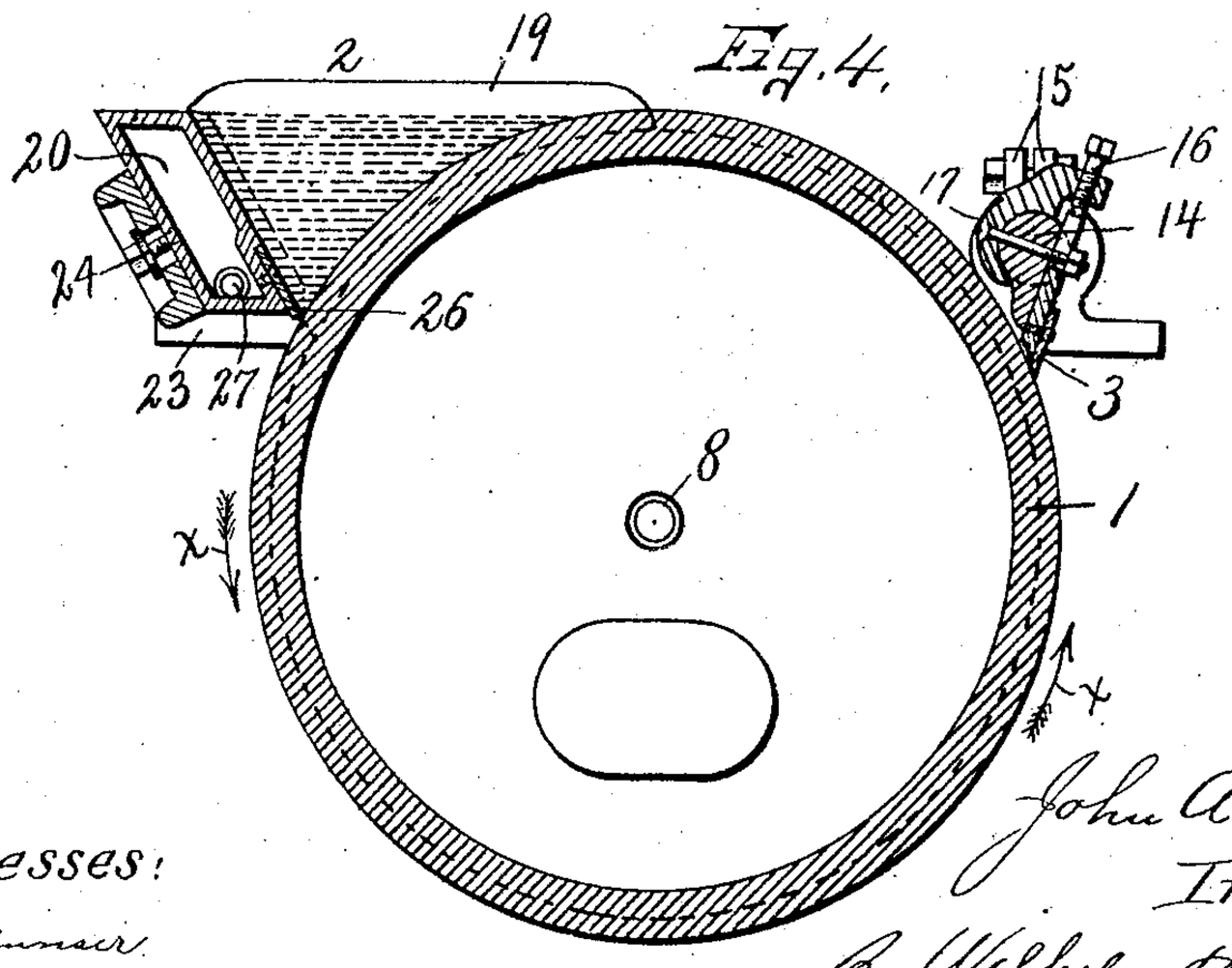


Fig. 4.



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NO MODEL. 4 SHEETS—SHEET 3.

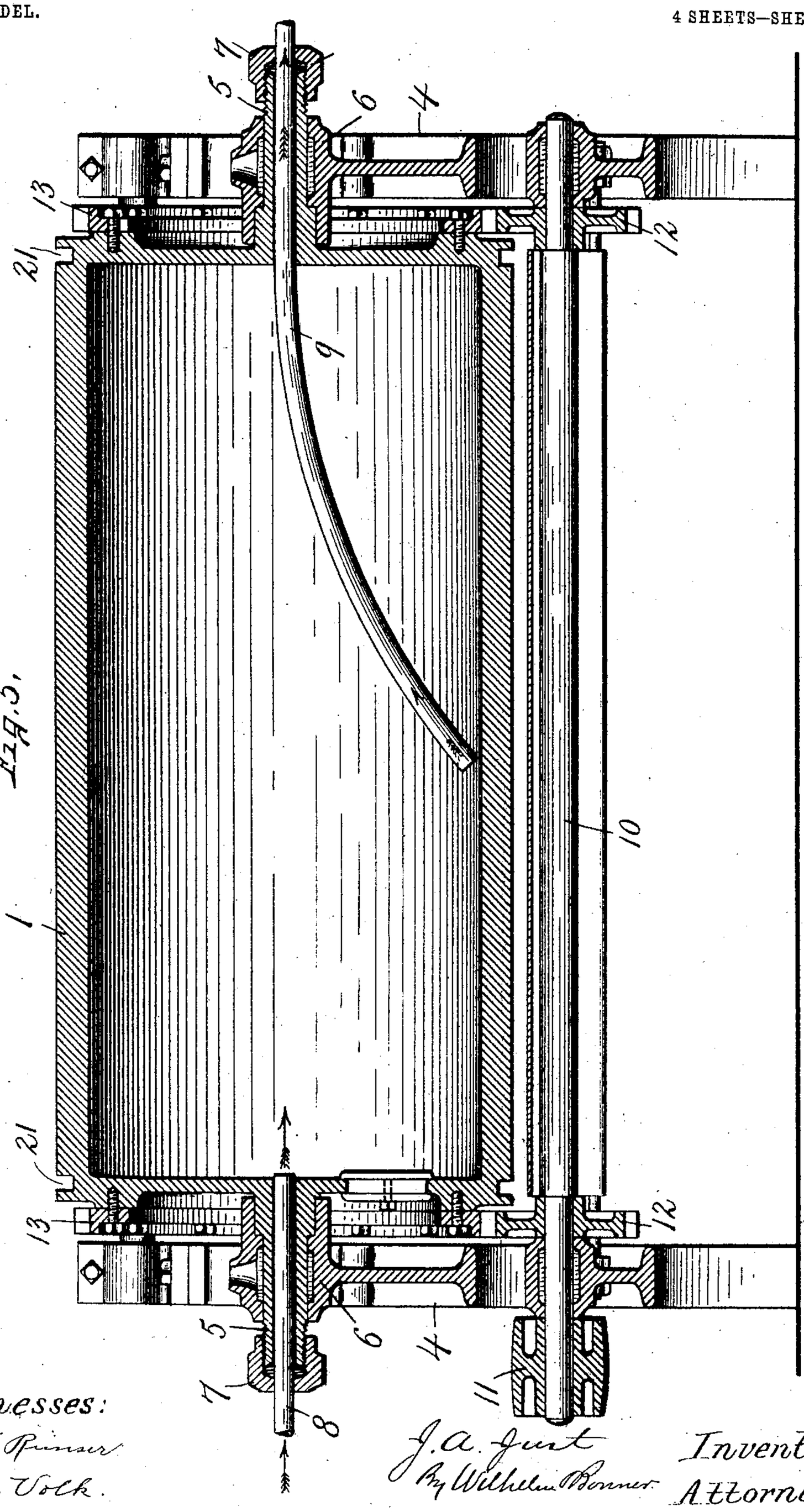

Fig. 5.

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APPLICATION FILED AUG. 31, 1903.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 6.

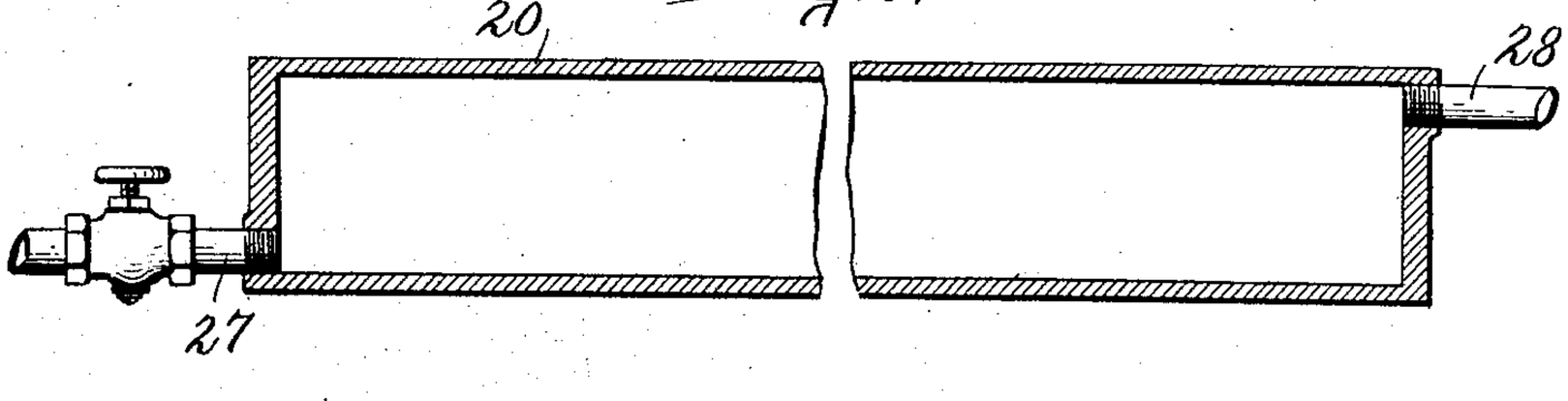


Fig. 8.

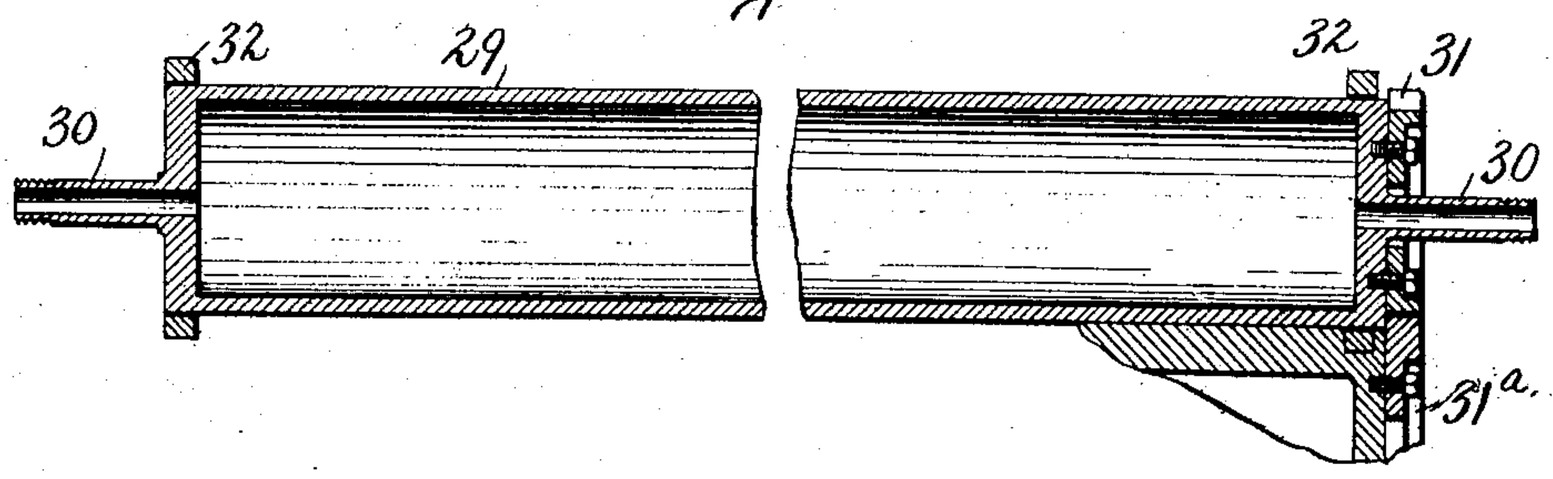


Fig. 7.

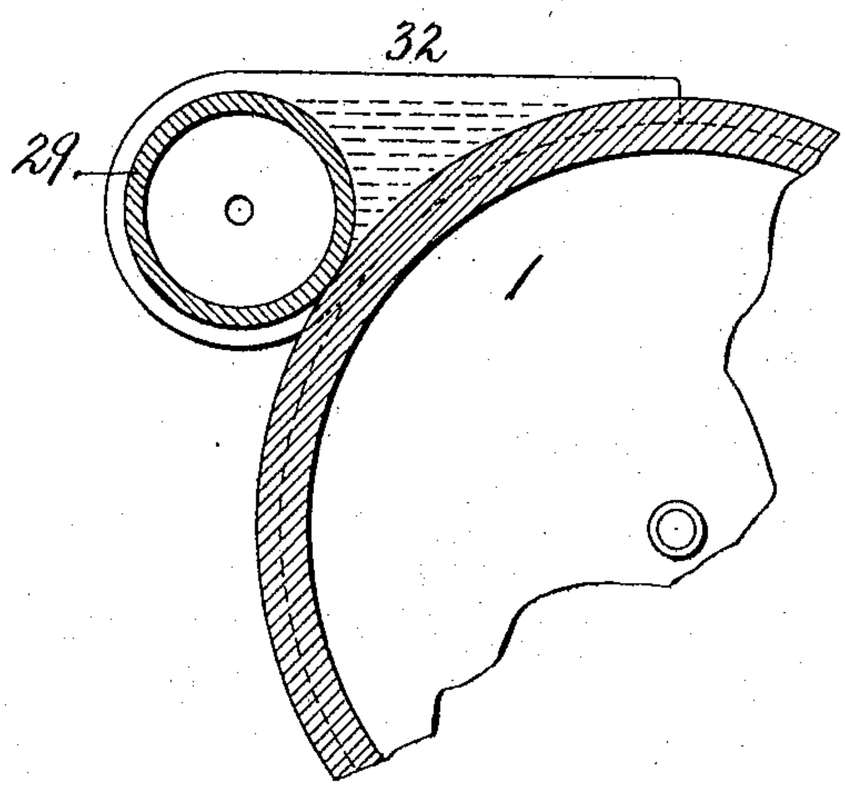
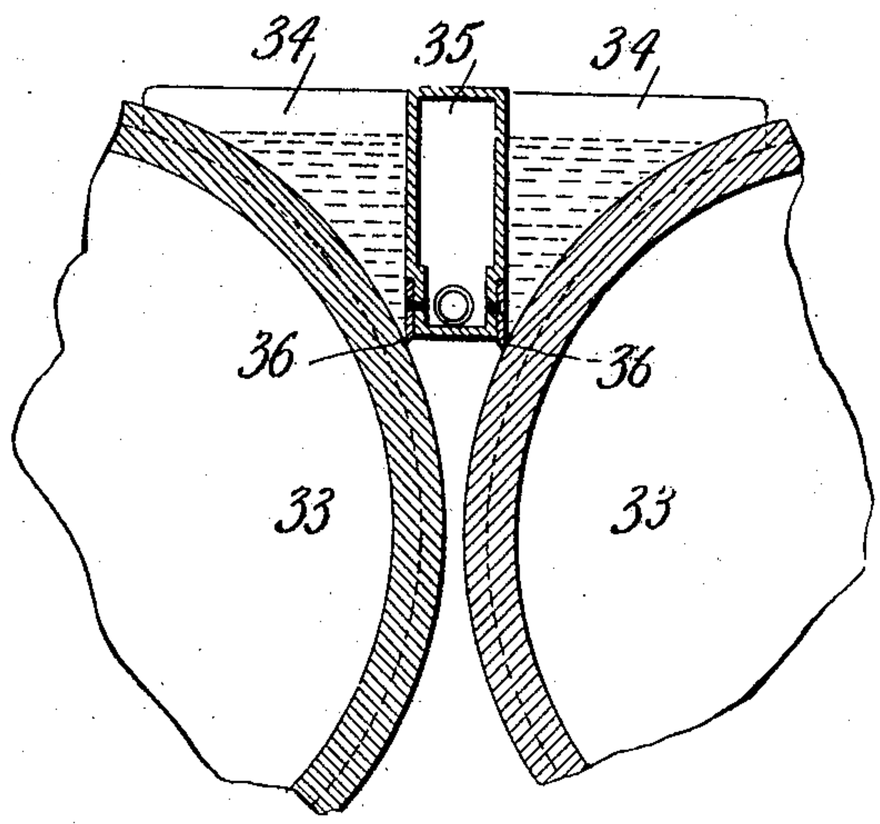


Fig. 9.



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No. 765,315. Patented July 19, 1904.

UNITED STATES PATENT OFFICE.

JOHN A. JUST, OF PULASKI, NEW YORK.

EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 765,315, dated July 19, 1904.

Application filed August 31, 1903. Serial No. 171,374. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. JUST, a citizen of the United States, and a resident of Pulaski, in the county of Oswego and State of New York, have invented a new and useful Improvement in Evaporating Apparatus, of which the following is a specification.

This invention relates to that class of evaporating-machines which are employed for evaporating liquids or semiliquids and which embody one or more rotary cylinders upon which the liquid is fed and on which the same is evaporated in a film, the dry residue forming a thin layer or sheet, which is removed from the cylinder by a scraper. The cylinder is heated by steam to a high degree of heat, usually above 212° Fahrenheit, the temperature depending somewhat upon the nature of the liquid and other considerations. In practicing this method of evaporation, whether on a single or a double cylinder evaporator, it is sometimes found that the film becomes hard or glazed on its surface. When this occurs, the evaporation does not proceed as rapidly as desirable, and this produces various objectionable results, particularly when the liquid operated upon is a delicate and complex liquid, like milk, skim-milk, buttermilk, whey, or a mixture of these liquids with farinaceous or other substances used as food products or a solution of casein.

When milk, whether full milk or skim-milk, is subjected in a thin film to a high degree of heat by contact with a surface heated to a temperature of from 212° to 270° Fahrenheit, the water contained in the milk forms almost instantaneously a steam-cushion on the heated surface, and the steam escaping from the boiling film usually carries off the heat so rapidly that no substantial change occurs in the solid constituents of the milk, the casein remaining in a soluble form and the milk-sugar remaining unchanged. In so evaporating milk for preserving it in a dry form it is of the utmost importance to apply sufficient heat to effectually sterilize the resultant dry product; but it is equally important to prevent the heat from reaching that point at which the casein, milk-sugar, salts, &c., undergo a change either physically or chemically. When the heat rises too high in the film, the casein is rendered more or less insoluble, the product assumes a yellowish or brownish tinge, resulting probably from a partial oxidation and a partial caramelization of the milk-sugar, either or both, and the flavor and taste are impaired. When a tough or glazed surface is formed on the film, the necessary rapid escape of steam from the film is prevented, and this causes an overheating of the film, whereby the properties of the resultant product are impaired as to its solubility, flavor, color, &c., in the case of milk mainly by the formation of more or less insoluble casein and a greater or less change in the milk-sugar.

The object of this invention is to avoid this difficulty and to construct the machine in such manner that enough heat can be applied to the film to drive off the moisture quickly and to thoroughly sterilize the product, while the heat is prevented from rising to the point at which the physical or chemical conditions of the solid ingredients contained in the liquid are changed, so that the machine produces a dry product which can be kept for a long time without deterioration, which contains the solid ingredients unaltered, and which produces by the addition of a proper amount of water a liquid closely resembling in properties the original liquid which was evaporated. This result is obtained by providing the machine with a cooling-chamber which faces the evaporating-cylinder and between which chamber and the cylinder the film passes, so that the film is subjected on one side to the high degree of heat furnished by the heated surface of the cylinder and on the opposite side to the cooling effect of the cooling-chamber. The cooling agent acting upon the outer side of the film prevents the formation of an impervious or glazed surface on the latter and keeps the film in an open or porous condition, permitting the free escape of the steam or vapor which is generated in the film, thus preventing the overheating of the material and the evils arising therefrom. This cooling-chamber may be constructed in various ways, some of which are herein shown and described.

In the accompanying drawings, consisting of four sheets, Figure 1 is a top plan view of an evaporating-machine provided with my improvements and containing a single cylinder. Fig. 2 is a front elevation thereof. Fig. 3 is an end elevation. Fig. 4 is a vertical cross-section in line 4 4, Fig. 2. Fig. 5 is a central longitudinal section of the machine. Fig. 6 is a longitudinal section through the cooling-chamber. Fig. 7 is a fragmentary cross-section of a machine provided with a cylindrical cooling-chamber. Fig. 8 is a longitudinal section through the cooling-chamber of this machine. Fig. 9 is a fragmentary cross-section of a double-cylinder machine provided with my improvements.

Like numerals of reference refer to like parts in the several figures.

Referring to Figs. 1 to 6, 1 represents the evaporating-cylinder, which may be of any usual construction and which is provided with the usual appliances for admitting steam to the interior of the cylinder and removing the water of condensation therefrom. 2 represents the feed-hopper for the liquid or semiliquid to be evaporated arranged on the upper descending side of the cylinder in the usual way, and 3 represents the scraper on the opposite side of the cylinder for removing the dried material therefrom. 4 represents the stationary end frames in which the cylinder is mounted by hollow trunnions 5, turning in bearings 6 and provided with stuffing-boxes 7 for making tight joints with the steam-inlet pipe 8 and the water-escape pipe 9, respectively. The cylinder is rotated by any suitable mechanism—for instance, as shown, by a shaft 10, driven by a pulley 11 and carrying pinions 12, which mesh with gear-rims 13, secured to the ends of the cylinder. The scraper 3 is preferably mounted upon a shaft 14, which is rotatably secured in clamp-bearings 15, so that the scraper can be adjusted toward and from the cylinder, and the scraper is also adjustable on the shaft by set-screws 16 and fastening-bolts 17 passing through slots in the scraper, Fig. 4. The clamp-bearings are adjustable on the stationary frame by set-screws 18. The receiving or feed hopper consists of end plates or walls 19, which stand at right angles to the axis of the cylinder, and a longitudinal wall 20, which consists of a hollow chamber, through which a cooling agent—for instance, water—is caused to flow. The end walls 19 have concave lower edges, by which they fit closely into annular grooves 21, formed in the cylinder near the ends thereof. These end walls are secured to the longitudinal chamber 20 by screws 22 passing through slots in the flanges of the end walls, so that the latter can be adjusted on the chamber toward and from the cylinder. The chamber is adjustably secured to a longitudinal inclined support 23 by screws 24, Fig. 4, passing through slots in said support, and the latter is adjustably secured to the stationary end frames by screws 25 passing through slots, Fig. 3. This permits the several members of the hopper to be adjusted with reference to each other and with reference to the cylinder and permits also of the adjustment of the hopper as a whole with reference to the cylinder. The contact edge of the hollow chamber 20 with the cylinder, which is the inner lower corner of the chamber, is preferably formed by a blade 26, Fig. 4, which may have an angular or a rounded edge. 27 represents the inlet-pipe through which the cold water or other cooling agent is supplied to the cooling-chamber 20, and 28 represents the escape-pipe for the water from the chamber. The liquid or semiliquid to be evaporated is placed in the receiving-hopper and forms therein a body of greater or less bulk, which rests at one side against the heated surface of the cylinder and at the other side against the cooled chamber. The liquid is drawn from this body in a film by the slow rotation of the cylinder in the direction of the arrow x, Fig. 4. The film passing through the narrow space between the cooling-chamber and the cylinder is acted upon during its formation on one side by the high heat of the cylinder and on the other side by the cooling-chamber. This prevents the film from becoming covered with an impervious or glazed skin or layer, but, on the contrary, keeps the outermost part or layer of the film open or porous and in the proper condition for permitting the instantaneous escape of the steam or vapor which is generated in the film. The cooling of the outer wall of the narrow opening in which the film is formed prevents the material from adhering to that wall, and thereby aids in producing a film of uniform thickness, whereby the overheating of parts of the film, which is very liable to occur when the film is uneven in thickness, is still further avoided.

In the machine represented in Figs. 7 and 8 the outer or front wall of the receiving-hopper is formed by a hollow roller 29, which is provided with hollow trunnions 30, one for the entrance of the cooling-water and the other for the escape of the water. The roller is preferably rotated in unison with the cylinder by gear-rims 31 31^a. The end walls 32 of the receiving-hopper are provided with circular openings, in which the roller fits closely. The cooling of the roller prevents the material from adhering to the same and keeps the roller clean and in good working condition.

In the machine represented in Fig. 9 two cylinders 33 are arranged near each other for the sake of compactness. The cylinders face each other with their descending sides, and each cylinder is provided with a receiving-hopper 34. The longitudinal walls of the two

hoppers are formed by a single cooling-chamber 35, having on each side a blade 36, by which it makes contact with the adjacent cylinder.

I claim as my invention—

1. The combination of a rotary evaporating-cylinder, a feed-receptacle for the liquid to be evaporated, and a cooling-chamber which is arranged at the outlet of the feed-receptacle and separated from the surface of the cylinder by a flow-space through which the film to be evaporated passes, whereby the film is exposed on opposite sides to the action of a heated and a cooled surface before being evaporated, substantially as set forth.

2. The combination of a rotary evaporating-cylinder, a feed-receptacle for the liquid to be evaporated arranged at the upper descending portion of the cylinder and opening downwardly, and a cooling-chamber arranged at the outlet of the feed-receptacle and separated from the surface of the cylinder by a flow-space through which the film to be evaporated passes, substantially as set forth.

3. The combination of an evaporating-cylinder and a feed-receptacle for the liquid to be evaporated, said receptacle having its longitudinal wall formed by a cooling-chamber which is arranged in close proximity to the cylinder, substantially as set forth.

4. The combination of an evaporating-cylinder and a feed-receptacle for the liquid to be evaporated, said receptacle having one wall of its discharge-opening formed by a cooling-chamber which is arranged in close proximity to said cylinder, substantially as set forth.

5. The combination of a rotary evaporating-cylinder, and a feed-receptacle arranged against the face of said cylinder, said receptacle having its longitudinal wall provided with a cooling-chamber which is arranged with its lower end in close proximity to said cylinder, substantially as set forth.

6. The combination of a rotary evaporating-cylinder and a stationary feed-receptacle arranged against said cylinder and having its outer wall formed by a cooling-chamber, substantially as set forth.

7. The combination of a rotary evaporating-cylinder and a feed-receptacle composed of a stationary cooling-chamber extending lengthwise of the cylinder and end walls arranged transversely to the cylinder and secured to said cooling-chamber, said cooling-chamber being arranged with its lower end in close proximity to the cylinder, substantially as set forth.

8. The combination of a rotary evaporating-cylinder, a stationary frame in which the same is mounted, a feed-receptacle having a cooling-chamber arranged lengthwise of the cylinder with its lower end in close proximity thereto, and means for adjusting said feed-receptacle on said frame toward and from said cylinder, substantially as set forth.

9. The combination of a rotary evaporating-cylinder, a stationary frame in which the same is mounted, and a feed-receptacle composed of a cooling-chamber arranged lengthwise of the cylinder with its lower end in close proximity thereto and end walls arranged transversely to the cylinder, means for adjusting the cooling-chamber on the stationary frame toward and from the cylinder, and means for adjusting the end walls on the cooling-chamber toward and from the cylinder, substantially as set forth.

10. The combination of a rotary evaporating-cylinder provided with annular grooves near its ends and a feed-receptacle arranged against said cylinder and having its transverse end walls extending into the grooves thereof, substantially as set forth.

Witness my hand this 28th day of August, 1903.

JOHN A. JUST.

Witnesses:
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