

Apr. 10, 1923.

M. C. MABEE

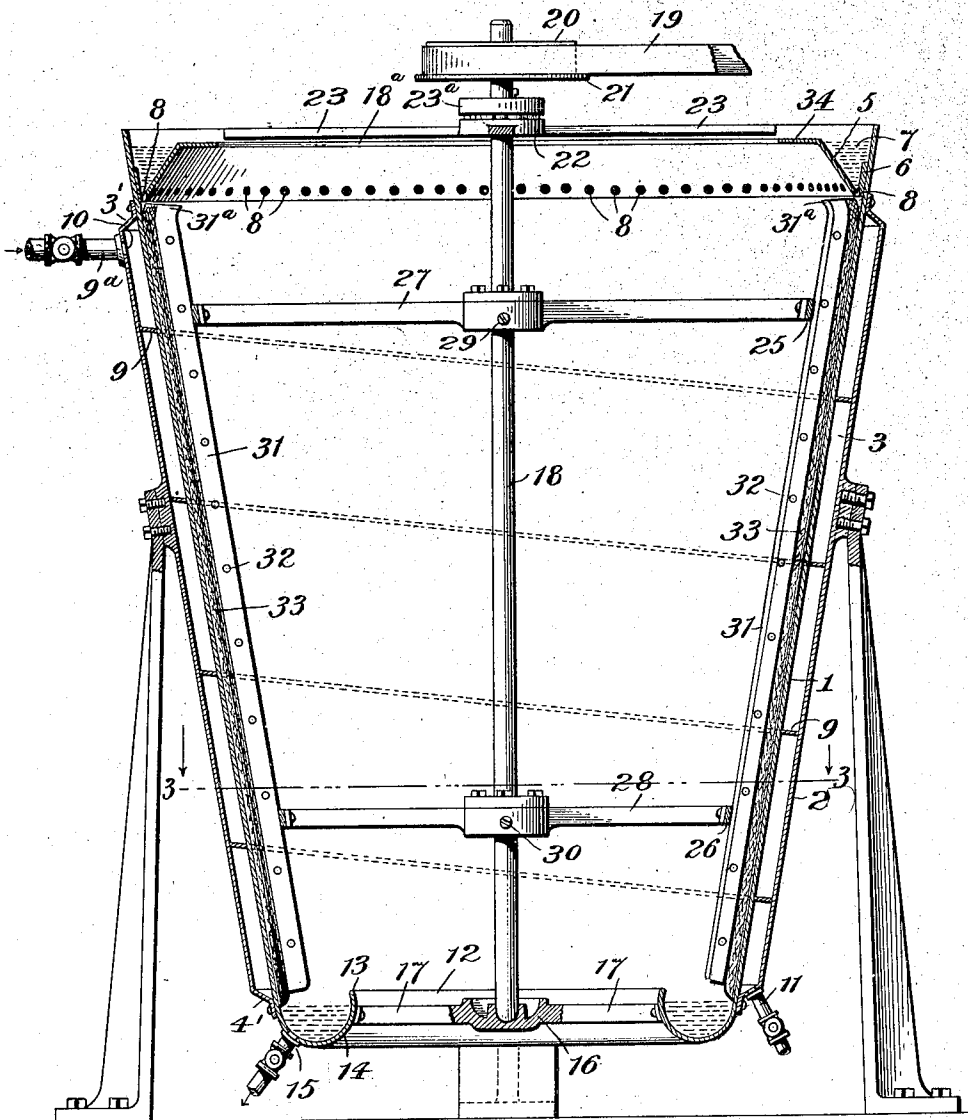
1,451,168

APPARATUS FOR TREATING MATERIALS

Original Filed Sept. 11, 1915

2 sheets-sheet 1

Fig. 1.



Witnesses:

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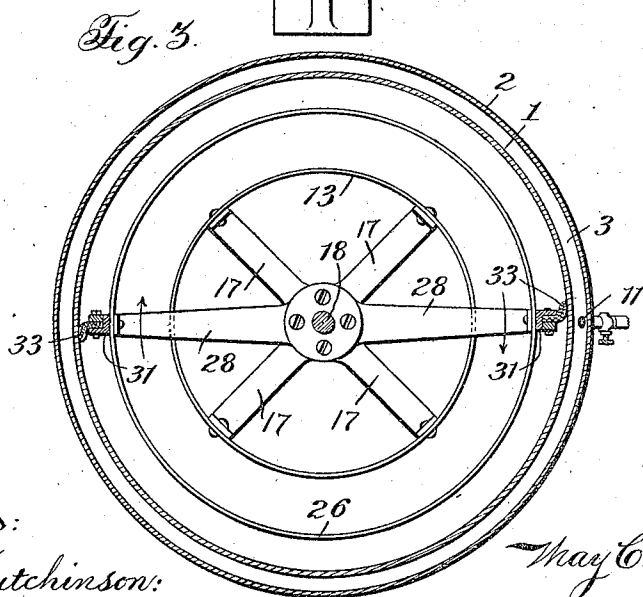
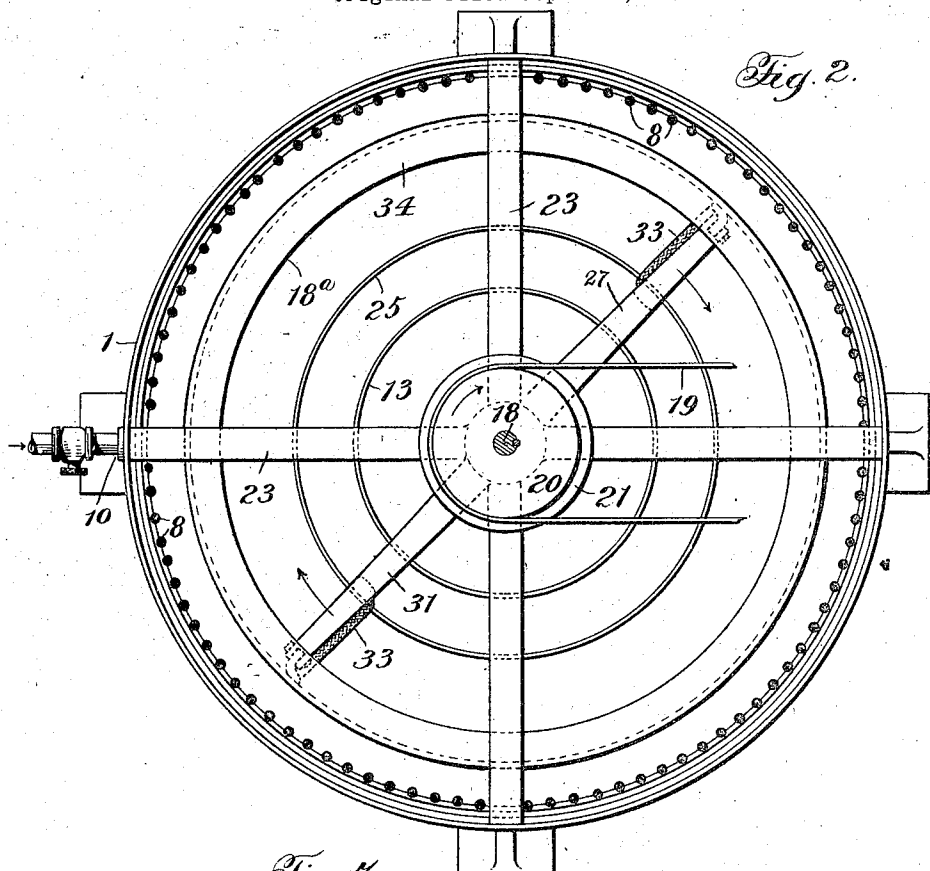
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APPARATUS FOR TREATING MATERIALS

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Witnesses:

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR TREATING MATERIALS.

Application filed September 11, 1915, Serial No. 50,225. Renewed June 29, 1922. Serial No. 571,766.

To all whom it may concern:

Be it known that I, MAY C. MABEE, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Apparatus for Treating Materials, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to an apparatus for heating, evaporating, and otherwise treating liquids or substances containing liquid to change the condition or consistency thereof.

In the art of treating fluids, and particularly that art wherein it is sought to heat or pasteurize the material, cylindrical containers have been largely employed, the containers having associated therewith means for heating the treating surface thereof, and these containers being usually arranged vertically and having relatively movable means within the container for feeding the material from the lower or inlet end thereof to the upper or outlet end of the container.

In this type of apparatus just referred to, centrifugal force has been depended upon as the means for forcing the material outwardly into contact with the treating surfaces of the cylindrical container and for causing the material to flow from the lower inlet end of the container, to the upper outlet end thereof.

By the present invention, it is proposed to provide a tubular drum or container, the walls of which taper from one end to the other, and with the inlet for the material arranged adjacent that portion of the container of increased diameter, and with the outlet for the treated material arranged adjacent that end of the tubular container of reduced diameter.

It is also proposed to preferably arrange the tubular container vertically, or substantially vertically, with the enlarged inlet end thereof disposed uppermost with the result that the material as fed into engagement with the interior treating surface of the container, will remain in contact with said surface by the power of adhesion and the power of gravitation, which tend to maintain the material in contact with said surface by reason of the peculiar shape and disposition of the surface.

It has been ascertained that by the improved apparatus contemplated herein, better and more satisfactory results are accom-

plished, than in prior devices adapted for the same purpose, more uniform treatment of the material is possible, and at the same time there results, considerable saving of time in treatment and cost of operation.

Again, by the improved apparatus herein described and claimed, the necessity of the provision of centrifugal force, primarily depended upon heretofore, is substantially avoided by the peculiar construction and arrangement of the parts of the apparatus, thus further tending to simplicity in construction and operation with less expenditure of power in the operation.

It is further contemplated by the present invention to provide means whereby the material as delivered into the enlarged inlet end of the container will be more evenly distributed in the form of a substantially continuous layer extending over the entire circular area of the treating surface, and whereby said layer of material is caused to move in a spiral path over said surface as it by force of gravity seeks the lowermost or outlet end of the container, the said means preferably having associated therewith means whereby the treating surface is constantly maintained in a cleansed or polished condition free from adhering particles of material or objectionable incrustation of the material on the treating surface, which might tend to burn, scorch, or otherwise destroy the natural flavor of the material being treated, and which would likewise interfere with the high and rapid heat transmission contemplated.

More particularly, the invention includes a tapered tubular container preferably arranged vertically with an inlet for the material adjacent the enlarged end of the container which is disposed uppermost and an outlet adjacent the base of the container, means for applying to the treating surface of the container a temperature different from that of the material to be treated, and means within the container, the said means and the said treating surface being relatively movable about a vertical axis whereby the material as fed into the container is caused to move longitudinally thereof towards the outlet and is also caused to move in layer formation spirally over said treating surface.

The invention further includes means whereby the heating medium is caused to move in a helical course around the tapered treating surface.

Other and further improvements and

novel details in the construction and arrangement of the various parts of the apparatus will be pointed out in the description to follow, which for a clear understanding thereof is to be considered in connection with the accompanying drawings, which form a part hereof, and wherein is disclosed for the purpose of illustration a convenient and satisfactory embodiment of the invention.

In the accompanying drawings, while a preferred embodiment of the invention is illustrated, yet it is to be understood that many minor changes may be made without departing from the spirit of the invention.

In the drawings:—

Figure 1 is a vertical section of a preferred embodiment of the invention.

Figure 2 is a top plan; and

Figure 3 is a transverse section substantially on the line 3—3 of Figure 1.

With more particular reference to the drawings, wherein like reference numerals refer to corresponding parts throughout the several views, 1 is a vertically disposed tubular container, the inner surface of which constitutes the treating surface proper for the material, which surface gradually tapers from a relatively enlarged upper end to the lower end thereof of reduced diameter. Surrounding the wall 1 of the container is a similarly tapered tubular jacket 2 of somewhat greater diameter than that of the container 1 whereby to form between the walls 1 and 2 a chamber 3 for the reception of a temperature transmitting medium to be hereinafter more particularly referred to. The jacket 2 at its top and bottom is formed with annular offset flanges 3' and 4' connecting with the outer surface of the container 1. Mounted on the wall 1 of the container is an annular wall 5, said wall in the embodiment of the invention illustrated being disposed within the container and secured to the wall 1 thereof as at 6, said wall 5 tapering in an opposite direction to the taper of the wall 1 whereby to provide a trough or receptacle for the reception of a supply of material 7 to be treated. The wall 5 is provided with one or more annular series of apertures 8 whereby to deliver the material from the annular trough onto the interior surface of the wall 1 at a plurality of points circumferentially of the treating surface. Any suitable means may be employed for delivering the material to be treated into the annular trough above referred to. The annular trough for the material preferably terminates at a point above and adjacent to the upper end of the annular jacket 2 whereby the temperature transmitting medium will act upon the material after delivery onto the treating surface.

The receiving chamber 3 for the temperature transmitting medium is conveniently

divided by a helically disposed partition 9 whereby to cause the material to flow in a circular path over the outer surface of the wall 1 in a general downward direction which tends to increase the speed of the flow of the temperature transmitting medium. The temperature transmitting medium is preferably steam at a high temperature, the same being delivered by a piping 9^a, from any suitable source and having an inlet into the chamber 3 adjacent the upper end as indicated at 10. An outlet for steam or water of condensation is provided adjacent the base of the jacket 2 and as illustrated at 11.

The material as delivered through the apertures 8 will, owing to the attraction of gravity flow downwardly over the interior wall or treating surface of the container 1, the said movement being gradual because of the power of adhesion, and the moving body of steam over the opposite surface of said wall 1 will result in rapid high heat transmission to the material, the vapors being allowed to pass off into a central zone within the film or layer of material. Conveniently, unrestricted outlets for these vapors or gases are provided at both the top and bottom of the container, though in this connection, it is to be borne in mind that for certain treatments it may be desirable to close one or both ends of the container. Especially is this true in the event the apparatus is to be used in connection with a multiple effect system, when both ends of the container will be closed with one end having an opening communicating with the vapor zone within the film or layer of material whereby to connect with a second unit or effect in the system. In the event the container is provided with open ends, a satisfactory form of construction is illustrated in the drawing, wherein the top of the receptacle has a substantially unrestricted opening from edge to edge thereof, and wherein an opening 12 is provided at the base thereof.

The wall 1 at the base thereof is provided with an inwardly and upwardly extending flange or projection 13 forming an annular receiving trough or receptacle 14 for the treated material, an outlet 15 connecting with said annular receiving receptacle 14 and leading to any suitable place of deposit.

It is desirable that the material assume a substantially continuous spiral layer formation and at the same time be subjected to a rotatable movement as the same flows towards the outlet end of the container, and it is also desirable that the treating surface be maintained in a cleansed or polished condition, free from adhering particles or incrustations, and with this in view instrumentalities substantially as follows may be employed. 16 is a suitable cup-shaped bear-

ing arranged centrally of the space within the flange 13, and conveniently secured to said flange as by arms 17. 18 is a shaft having a bearing at its lower end within the bearing 16 and projecting at its upper end above the top of the container and having associated therewith means for rotating the same at a sufficient speed to impart circumferential movement while at the same time permitting simultaneous downward movement under force of gravity.

In the embodiment of the invention illustrated, the shaft is conveniently rotated through the medium of a belt or other drive 19 (cut-away in the drawing) mounted upon a suitable pulley 20 fixed to the shaft 18, said pulley having extended flanges 21 whereby to maintain the belt in proper position on the pulley. A disk-shaped abutment member or bearing 22 sleeved upon the shaft 18 is suitably supported from the container as by arms 23 projecting across the top of the container and secured to the upper edges of the wall 1. A cooperating disk or abutment member 23^a is secured to the shaft 18 at a point above and adjacent the bearing 22 whereby to engage the latter in the rotatable movement of the shaft, and in this connection, if desired, suitable ball bearings may be inserted between opposed surfaces of the members 22 and 23. Mounted on the shaft for rotatable movement therewith are one or more wiper members, it being noted in this connection that any desired number may be used, but in the illustration, only two of said members are shown, they being arranged opposite to one another and mounted upon annular rims or flanges 25 and 26 respectively, secured to spokes or webs 27 and 28 respectively removably fixed to the shaft 18 in any desired manner as illustrated at 29 and 30 respectively. Projecting between the annular members 25 and 26 are inclined arms 31 preferably taking the form of angle bars having secured thereto as at 32 suitable wiper members 33 of suitable material which latter are adapted to move adjacent to or in wiping contact, with (preferably the latter), the interior or treating surface of the container 1. It is obvious of course, that the wiper members 33 may take various forms and constructions, and that brushes or the like may be utilized instead of the yieldable material illustrated. The arms 31 are preferably offset outwardly as illustrated at 31^a, whereby to impart a downward tendency to the flow of the material as the arms are rotated, and in this connection, the container is preferably provided adjacent its upper end at a point above the inlet opening 18^a with an internal annular flange 34, whereby to constitute an obstruction or abutment, to overcome any tendency of the material flowing upwardly under the action of the rotatable arms 31.

The operation may be reviewed as follows:

The material being fed into the annular receptacle at the top of the container finds an outlet at a number of closely associated points circumferentially of the container immediately engages the inner surface of the container which said surface has applied thereto a heat transmitting medium preferably steam at a high temperature, the steam being continuously fed into the chamber 3 surrounding the treating surface and following a helical course in a downward direction around said surface until it finds an outlet at 11. The steam chamber at the upper end begins where the motion of the material within the container commences, and ends at the lower extremity where the motion terminates, with the result that the entire heating surface is used advantageously, and none of the products will be allowed to burn, scorch or otherwise have imparted thereto an injurious flavor because of unequal heat transmission. The attraction of gravity being in a vertical line, the action of the present apparatus distinguishes from prior similar apparatus, wherein the material is forced outwardly and formed in a layer by centrifugal force and maintained in layer form by centrifugal force while moved from the lower to the upper end of the container, since in the present apparatus, the material as fed into the container adheres to the treating surface owing to the power of adhesion or the attraction of bodies of different natures to each other, and the power of gravitation which tends to draw the body towards the gradually tapering surface of the container. Instead of forcing the material outwardly and holding the material outwardly by centrifugal force, the material is forced inwardly and spirally downward by virtue of the peculiar construction contemplated herein. The material entering through the apertures 8 and coming in contact with the interior surface of the container is engaged by the upper end of the revolving wipers and formed into a continuous circular movable sheet or layer. As the material reaches the lower end of the container, it falls into the annular receiving chamber 14, and finds an outlet through the conduit 15 which is the outlet being preferably tangentially disposed.

Owing to the helical arrangement of partitions 9 in the steam chamber, the steam will travel at a higher velocity, and the condensation will readily flow over the helically disposed surfaces provided by the partitions 9, thereby leaving the exterior surface of the wall 1 substantially free from water of condensation, and allowing the heat to be transmitted more readily.

It will be observed that while the wiper members 31 are described as preferably ro-

tatable at approximately a certain speed, and the heat transmitting medium, steam, at a preferred temperature, it is to be understood that the speed of rotation of the wiper members as well as the temperature of the heat transmitting medium may be varied to suit conditions in accordance with the desired treatment, or the material being treated. The figures mentioned in the description are illustrative, and the construction operating in accordance therewith has proven highly satisfactory for the purposes of heating and pasteurizing, but the use of the structure is not to be limited in this respect, since obviously, it is within contemplation of the present invention to otherwise treat material as the evaporation of water from substances, or reduction of substances to powder, etc.

In my copending application, Serial No. 50,224, I have illustrated a construction somewhat similar to that illustrated and described herein, but in the said copending application the elongated vertically disposed tubular wall is in the form of a cylinder as distinguished from being inclined or tapered inwardly from the upper edge thereof to the lower edge thereof, as disclosed herein; and I do not herein claim any subject-matter specifically claimed in the said copending application Serial No. 50,224.

What is claimed is:

1. In an apparatus of the character described, the combination of a tubular container, the inner surface of which tapers substantially from end to end, means for externally applying heat to the wall of said container, said container having an inlet for the material treated adjacent that end thereof of greater diameter, and an outlet adjacent the opposite end thereof, means within the container extending longitudinally thereof adjacent the inner surface, means for imparting a relative rotatable movement between said means and wall of the container, the said longitudinally extending means operating to spread the material circumferentially over the surface of the container, said container having at one end an opening for the free escape of vapors from the central zone of the container.

2. In an apparatus of the character described, the combination of a tubular container, the inner surface of which tapers substantially from end to end thereof, means for applying to the wall of the container a temperature different from that of the material to be treated, said container having an inlet for the material to be treated adjacent the enlarged end at the periphery thereof, and an outlet adjacent the opposite end thereof, and said container having a relatively large central opening at one end for the free escape of vapors, means within the

container extending longitudinally thereof adjacent the treating surface, and means for imparting rotatable movement between said means and said treating surface, whereby to maintain a movable layer of material under treatment from its point of introduction to its exit from the container.

3. In an apparatus of the character described, the combination of a tubular container, the wall of which tapers from end to end, means for applying to the wall of the container a temperature different from that of the material to be treated, said container having at its enlarged end an inlet and at its smaller end an outlet for the material, a longitudinally extending member within the container adapted to contact the treating surface thereof, means for imparting a relative circumferential movement between said means and the treating surface whereby to positively spread the material circumferentially over said surface and cause the same to move circumferentially in the form of a layer in contact with said surface, and an outlet in one end of the container for the escape of vapors.

4. In an apparatus of the character described, the combination of a tubular container having a central quiet zone, the wall of which gradually tapers inwardly from the inlet to the outlet end thereof, means for applying to the wall of the container a heat transmitting medium of a high temperature, means whereby the material is allowed to flow by force of gravity while in contact with the wall of the container from the inlet to the outlet end thereof, and means whereby the material is applied in layer formation circumferentially over the treating surface and caused to rotate while in layer formation over said surface, said container having an opening at one end for the escape of vapors from the central quiet zone within the layer of material.

5. In an apparatus of the character described, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from the top to the bottom thereof, said container having an inlet in its side wall for the material adjacent said enlarged top and an outlet for the treated material adjacent the bottom thereof, means whereby the material is caused to move downwardly over the treating surface while subjected to a positive rotatable movement in layer formation circumferentially over said surface, means for applying to the wall of the container a heat transmitting medium of high temperature, and said container being open at opposite ends for the escape of vapors.

6. In an apparatus of the character described, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from the top to the bottom

thereof, said container having an inlet at its side for the material adjacent said enlarged top and an outlet for the treated material adjacent the bottom thereof, means whereby the material is caused to move downwardly over the treating surface while subjected to a positive rotatable movement in layer formation circumferentially over said surface, said inlet for the material being arranged at a plurality of points circumferentially of the container, and said container being constructed whereby to provide a free escape for the vapors.

7. In an apparatus of the character described, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from the top to the bottom thereof, said container having an inlet for the material adjacent said enlarged top and an outlet for the treated material adjacent the bottom thereof, means for applying heat to the wall of the container, and means within the container extending longitudinally thereof adjacent the inner surface and in yieldable contact therewith adapted to apply the material in layer formation extending over said surface and to wipe the surface of the container, and said container having a free end escape for the vapors from the center of the container.

8. In an apparatus of the character described, the combination of a tapered tubular container having an inlet for the material adjacent the enlarged end thereof and an outlet adjacent the opposite end thereof, means for applying to the wall of the container a temperature different from that of the material being treated, and the inlet for the material being arranged at the periphery of the container and adapted to deliver the material at a plurality of points circumferentially of the container, means for imparting positive rotatable movement to the material while permitting lengthwise movement of the material downward over the tapered surface, and said container having a free opening for the escape of vapors from the central zone within the layer of material.

9. In an apparatus of the character described, the combination of a vertically disposed tapered tubular container with the enlarged end uppermost, means for applying to the wall of the container a temperature different from that of the material being treated, means for feeding the material to the inner surface of the container at a plurality of points about the circumference thereof, adjacent the enlarged upper end thereof, an outlet for the material adjacent the base thereof, and surface engaging means for causing the material as it moves from end to end of the container to assume a movable circular layer formation over the surface of the container.

10. In an apparatus of the character de-

scribed, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from the top thereof, means for applying to the wall of the container a temperature different from that of the material being treated, said container having in its side wall a plurality of inlet openings for the material arranged circumferentially adjacent the enlarged upper end thereof and an outlet adjacent the base thereof for the treated material, a plurality of simultaneously rotatable spaced surface engaging conveyor and wiper members, and said container being open at opposite ends for the free discharge of vapors.

11. In an apparatus of the character described, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from top to bottom, a jacket surrounding the wall of the container, means for introducing a heating medium into the space between the wall of said container and said jacket, a member cooperating with the wall of the container adjacent the top thereof to form a receptacle for material, said receptacle having a discharge for feeding the material to the inner surface of the container at a plurality of circumferentially spaced points, a movable wiper member within the container to engage said surface, and the container having a free escape for the vapors arising in the central portion of the container.

12. In an apparatus of the character described, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from top to bottom, a jacket surrounding the wall of the container, means for introducing a heating medium into the space between the wall of said container and said jacket, a member cooperating with the wall of the container adjacent the top thereof to form a receptacle for material, said receptacle having an opening at a plurality of points circumferentially of the container for feeding the material to the inner surface of the container, and a movable wiper member within the container to engage said surface, said container having an opening at opposite ends for the escape of vapors.

13. In an apparatus of the character described, the combination of a vertically disposed tubular container the wall of which tapers inwardly from top to bottom, a jacket surrounding the wall of the container, means for introducing a heating medium into the space between the wall of said container and said jacket, a member cooperating with the wall of the container adjacent the top thereof to form a receptacle for material, said receptacle having an opening at a plurality of points circumferentially of the container for feeding the material to the inner surface of the container, a movable wiper member within the container to en-

gage said surface, said receptacle having an annular receiving trough for the treated material at the base thereof and an outlet from said trough.

14. In an apparatus of the character described, the combination of a tapered tubular container having an inlet for the material adjacent one end and an outlet adjacent the opposite end, means for causing the material to assume a movable layer formation over the inner surface of the container and for permitting the material to move from the inlet to the outlet end of the container, said container having a free end discharge for the ready escape of vapors arising in the central portion of the container and means for causing a heating medium to move in a spiral path exteriorly over the wall of the treating surface of the container.

15. In an apparatus of the character described, the combination of a vertically disposed tubular container having an inlet at the top and an outlet at the base thereof, the inner treating surface of the container tapering inwardly towards the base thereof whereby the material will flow downwardly over said surface by force of gravity and power of adhesion, spaced yieldable members for spreading the material in layer formation circumferentially over said surface, said container being open at opposite ends, and means for applying to the wall of the container a temperature different from the material being treated.

16. In an apparatus of the character described, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from the top to the base thereof, said container having an inlet adjacent the top thereof, an internal flange adjacent the top of the container above the inlet for the material, means for applying to the wall of the container a temperature different from that of the material being treated, and a rotatable wiper member extending longitudinally of the container ad-

jacent the inner surface thereof, means for rotating said wiper member at a high speed whereby to maintain a continuously movable layer of material circumferentially of the container, and said container having a free escape centrally for the vapors.

17. In an apparatus of the character described, the combination of a vertically disposed tubular container, the wall of which tapers inwardly from top to bottom thereof, means for applying to the wall of the container a temperature different from that of the material being treated, said container having an inlet adjacent the enlarged end thereof, and an outlet adjacent the base for the treated material, and a rotatable member extending longitudinally of the container adjacent the inner surface thereof, the upper end of said member being offset, said conveyor member being rotatable at a high speed whereby to positively maintain a rotatable movable layer, and said conveyor having a free escape for vapors centrally of the layer.

18. In an apparatus of the character described the combination of a vertically disposed open ended tubular container having a stationary treating surface tapering inwardly from the top to the bottom thereof, means for introducing the material to be treated directly on to said treating surface at the upper edge thereof at a plurality of points circumferentially thereof, exterior means for applying steam at a high temperature to said surface, and separated members of yieldable material extending longitudinally of the treating surface and adapted to contact therewith, said separated members being adapted to rotate at a high speed whereby to maintain a continuously moving rotatable layer of material as it falls downwardly over the treating surface by force of gravity.

In testimony whereof I hereunto affix my signature.

MAY C. MABEE.