

E. N. TRUMP.
APPARATUS FOR DRYING MOIST MATERIAL.

APPLICATION FILED APR. 25, 1901.

NO MODEL.

2 SHEETS—SHEET 1.

Fig. 2.

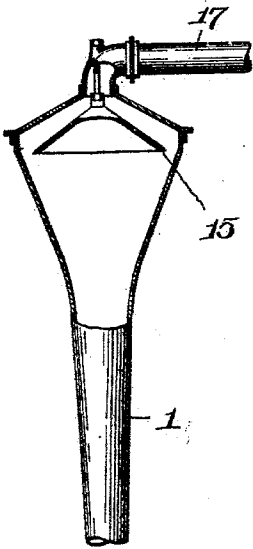


Fig. 1.

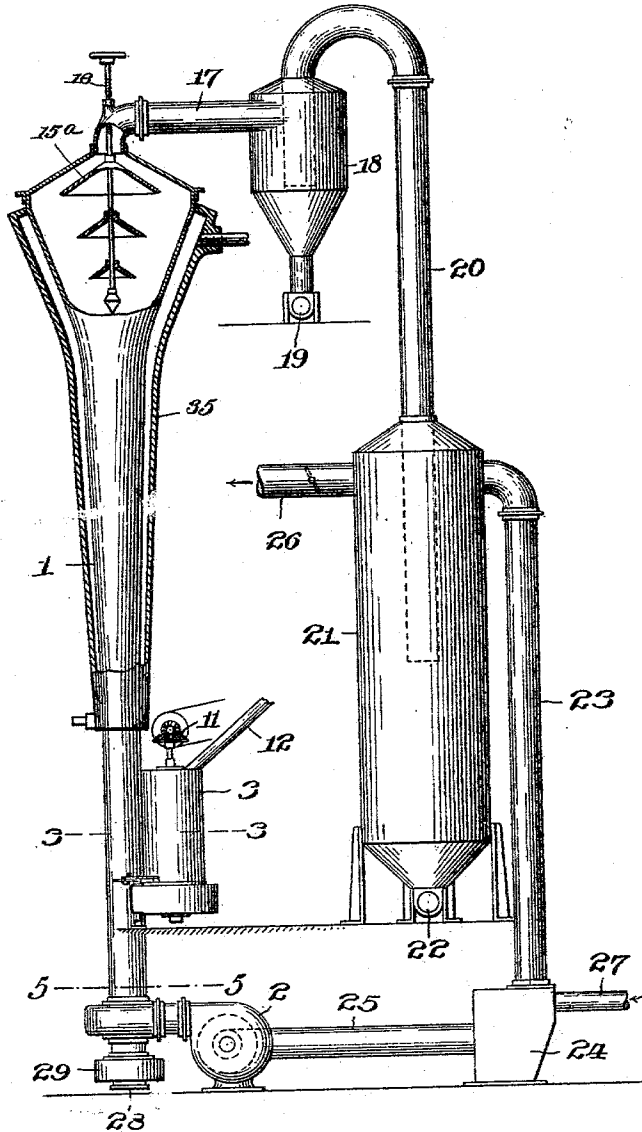


Fig. 3.

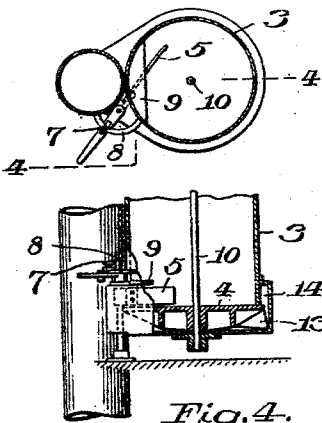
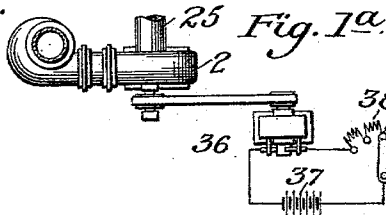


Fig. 4.

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No. 748,893.

PATENTED JAN. 5, 1904.

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2 SHEETS—SHEET 2.

Fig. 5.

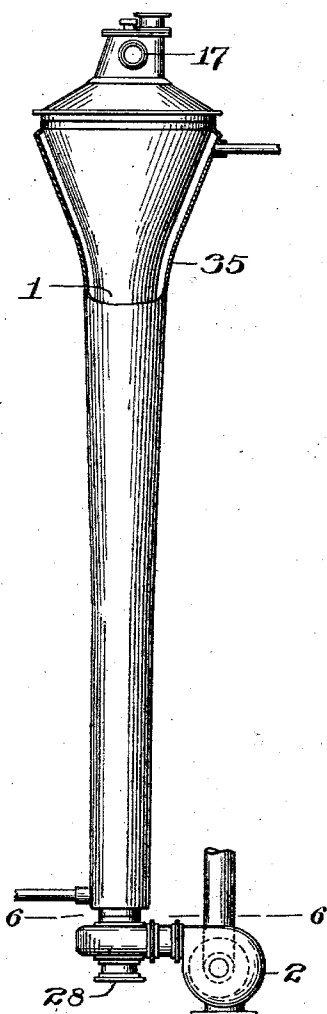


Fig. 7.

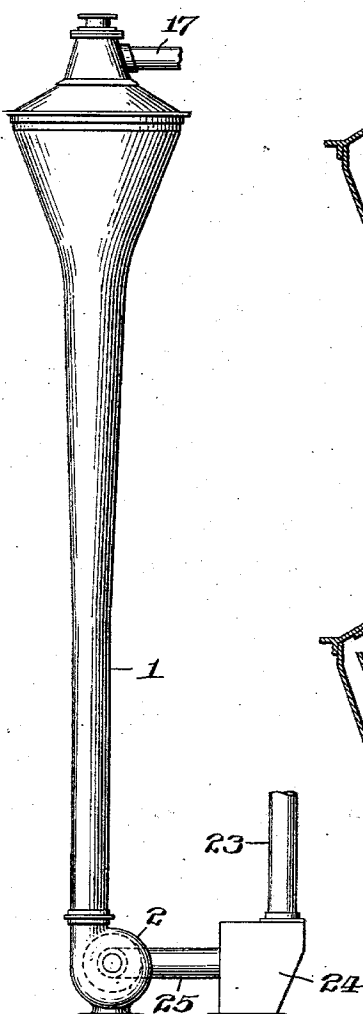


Fig. 8.

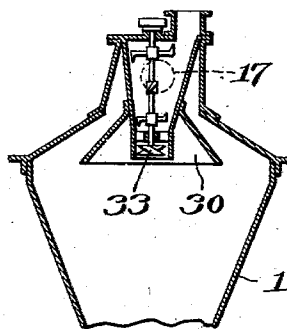


Fig. 9.

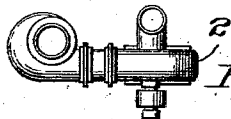
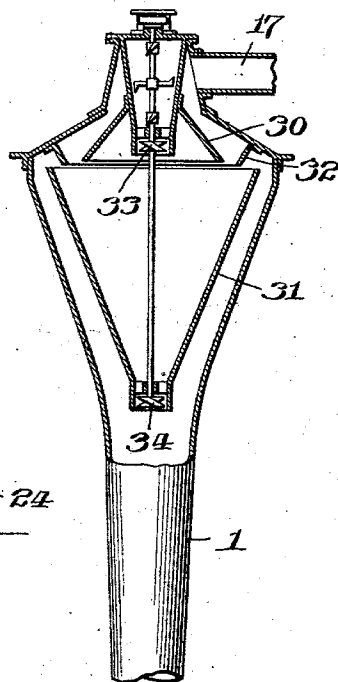


Fig. 6.

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UNITED STATES PATENT OFFICE.

EDWARD N. TRUMP, OF SYRACUSE, NEW YORK.

APPARATUS FOR DRYING MOIST MATERIAL.

SPECIFICATION forming part of Letters Patent No. 748,893, dated January 5, 1904.

Application filed April 25, 1901. Serial No. 57,418. (No model.)

To all whom it may concern:

Be it known that I, EDWARD N. TRUMP, a citizen of the United States, residing at Syracuse, in the county of Onondaga and State of New York, have invented new and useful apparatus for drying moist materials, absorbing gases or vapors, or decomposing and driving off gases from materials requiring such treatment, or other similar purpose, of which

the following is a specification.

My invention relates to improvements in apparatus for drying moist materials, absorbing gases or vapors, or decomposing and driving off gases from materials requiring such treatment, or other similar purpose.

My purpose is to bring a moving current of gas, air, or other treating agent into intimate contact with the material in such a manner as to automatically separate and discharge the finished material as soon as the work is complete, at the same time imparting to or extracting from it the required amount of heat to extract or impart moisture or gas or to decompose the material.

The essential feature of my invention is to induce a current of treating agent which shall act oppositely to the initial movement of the raw material to cause its suspension, but which shall afterward select and carry off with said current the finished material—for instance, by introducing the particles of material into an upwardly-moving current of treating agent of varying velocity, by which it is first suspended against the action of gravity, and as its specific gravity is changed by the action of the treating agent its position is automatically changed until the desired purpose is attained and the material discharged.

Referring to the drawings, Figure 1 is a view in elevation of my apparatus. Fig. 1^a is a plan view below the line 5 5 of Fig. 1 of the stack and blower, showing a rheostat-controlled electric motor for driving the blower. Fig. 2 is a detail of the upper part of the stack with part of the wall thereof broken away to show a modification in baffle-plate. Fig. 3 is a horizontal section, slightly enlarged, on the line 3 3 of Fig. 1. Fig. 4 is a vertical section of the lower part of the table-feed on line 4 4 of Fig. 3. Fig. 5 is an elevation of part of my device, showing the

feed at the top of the stack and also a heating-jacket surrounding said stack. Fig. 6 is a plan view below the line 6 6 of Fig. 5. Fig. 7 is an elevation of the stack, showing means for introducing a direct vertical current into the bottom thereof. Fig. 8 is a cross-section, somewhat enlarged, of the upper part of the stack as shown in Fig. 7, showing means for feeding the material and arrangement of baffles; and Fig. 9 is a similar view showing modifications in baffle and feed.

Similar numerals refer to similar parts throughout the several views.

Referring to Fig. 1, the stack or chamber 1 is disposed vertically with respect to its longitudinal extension and has a gradually-increasing area of cross-section from near the middle portion to the top. The treating agent is introduced at the bottom of the stack by the fan or blower 2. It may be delivered into the stack in a direct upward or vertical direction, as would be the case by the construction shown in Fig. 7, or it may be delivered in a spiral tangent to the side, as the result of the construction shown in Figs. 1, 5, and 6, which will give it a whirling upward current in a spiral course for the purpose hereinafter stated. The material to be treated may be fed into the stack, either vertically, horizontally, or inclined, at any suitable point above the entrance of the treating agent or, in fact, in any manner so that the same will be brought into said current of treating agent.

In the devices shown in Figs. 5, 7, 8, and 9 a vertical feed is employed, consisting of a funnel-shaped opening provided with agitators and a screw 33 or screws 33 and 34 to assure the movement of the material into the stack.

In Fig. 1 I show a device employing a table-feed. (Shown in detail in Figs. 3 and 4.) This consists of the receptacle 3, having a revolving table 4 at or near its bottom, which coöperates with a blade 5 to deflect the material to be delivered through an intake-aperture in the stack. The blade 5 is adjustable, having a set-screw 7, adapted to coöperate with the arc 8 to change the angular position of the blade to cause it to encounter more or less of the material with each revo-

lution of the table, as may be desired. The horizontal segment or shield 9 is so disposed above the intake-aperture of the stack as to prevent the natural slope of the material from extending beyond the edge of the revolving table and to assure a steady feed that can be controlled or regulated. This also assures a continuous mass of material above the intake-aperture to form a seal over said intake to prevent the escape of treating agent from the stack. The revolving table 4 is mounted on the shaft 10 and may be driven by any suitable means operating through the gear 11. The material may be fed into the receptacle 3 through the trough or chute 12 or by any other suitable means. A plow or scraper 13 is secured to the under side of the revolving table and is adapted to feed into the stack the material that falls into the chamber 14 between the revolving table and the lower edges of the wall of the receptacle 3.

In Figs. 1, 1^a, 5, and 6 I show the means for inducing a current of treating agent, consisting of a fan or blower 2, delivering tangentially into the bottom of the stack, which causes an upward spiral current through the stack. The fan or blower 2 is driven by an electric motor 36, deriving its current from a source 37 and controlled by rheostat 38 to regulate the speed of said blower and the consequent velocity of the current induced.

In Fig. 2 the baffle-plate 15 is disposed approximately the exit-point or outlet of the treating agent and finished material and is adapted to cooperate in the separation of the finished from the raw material, as in the case of the baffle-plates 15^a in Fig. 1.

In Fig. 1 I show a baffle means in which a series of baffles 15^a are mounted upon a single shaft and correspond, respectively, to the relative areas of cross-section of the surrounding stack with respect to the position of each. The supporting-rod 16 is adapted to be raised or lowered as adjustable means for controlling the passage for the treating agent and the material carried thereby to the exit 17, such adjustment being desirable to meet the conditions of the different materials to be treated or the different ways of treating the same.

In Figs. 8 and 9 I show a further modification of baffles where the feed is in the top of the stack and through said baffles, the purpose being as above described and also to assure the separation of the outgoing from the incoming material.

In Fig. 9 I show oppositely-disposed baffle-plates 30 and 31 with an intermediate baffle 32, through all of which baffles the raw material is fed, the movement of same being assured by the screws 33 and 34. The purpose of this arrangement of baffles is to assure the separation from the outgoing material of material that is not perfectly finished or dried. As the said material strikes against the baffle 32 some of it is deflected over the edges of

baffle 31 and is carried downward with the raw material, while only the dry portion of the material escapes upward between the edges of baffles 30 and 32 and the exit 17.

In Figs. 1 and 5 I show the stack surrounded by a heating-jacket 35, into which hot air or gas, hot water, or steam may be introduced for heating the walls of the stack for the purpose hereinafter described.

The upper part of the stack communicates with the discharge-pipe 17, which leads to the separator 18 of the type known as the "cyclone" separator, which is provided at its base with the conveyer 19 to carry off the material separated from the treating agent passing through 18. The separator 18 is also connected with the pipe 20, leading to the dust-receiver or second separator 21. At the bottom of the dust-receiver 21 is a second conveyer 22, serving a similar purpose as that of conveyer 19. The dust-receiver 21 is also connected with the pipe 23, which carries the treating agent, now having been relieved of the material treated, downwardly to the heater 24, thence through pipe 25 to blower or fan 2, and back to the stack 1. The dust-receiver 21 is also provided with a valve-controlled exit 26 for releasing such part of the treating agent as may be desirable, and connected with the heater 24 is provided a valve-controlled inlet 27 for the purpose of taking in fresh treating agent as may from time to time be desirable. When gas is used, it is obvious that inlet 27 may be connected with any suitable gas-reservoir or source of gas-supply. (Not shown.) A port 28 is provided at the bottom of the stack for the purpose of taking out material that may have fallen below the blower or the current of treating agent maintained thereby by cause of too heavy feeding of material into the stack, or the larger receptacle 29 may be provided, as shown in Fig. 1, for collecting said material, so that it need only be removed at intervals.

The operation of my device is as follows: Taking, for example, the apparatus constructed as shown in Fig. 1, the material is fed into the stack 1 at 6 by the table-feed and encounters the current of treating agent rising from the blower or fan 2. Where the purpose is to dry finely-divided moist material, the current of treating agent is so regulated that the moist material will just remain suspended in the lower portion of the stack, being kept in motion by said upward current. As its weight decreases by the driving off of the moisture in the product, which is very quickly accomplished by the intimate contact with the treating agent, the material ascends toward the top of the stack, and when it becomes quite dry is carried off by the current of treating agent through pipe 17 to separator 18. The regulation of the current is accomplished by the regulation of the speed of the fan or blower 2. This may be accomplished, as shown in Fig. 1^a, by a rheostat-controlled electric motor or in any other of a number of well-

known ways. The treating agent delivered into the bottom of the stack is first heated in the heater 24 and gives up its heat to the material to be treated and to the moisture contained therein to cause its evaporation. It will also be noted that inasmuch as the area of cross-section of the stack is less at its lower extension the vertical velocity of the current of the treating agent will be greater there than in the upper portion of the stack, where the area of cross-section is greater, and the current of treating agent consequently becomes more dispersed, and thus loses in vertical velocity. By this loss of vertical velocity of the current, due to its gradually-widening spiral course consequent upon the increasing area of cross-section of the stack toward its upper extension, it results that at a certain distance above the intake-point of material the said vertical velocity of the current is insufficient to support or suspend the raw or wet material, but is only sufficient to suspend the drier or partially-finished material. The point at which the current will not suffice to suspend the raw or wet material will depend upon the adjustment of the initial speed of current, rate of feed, and condition of material and the various respective cross-sections and longitudinal dimensions of the stack.

As above indicated, by the proper adjustment of the above-mentioned factors of initial speed of current, rate of feed, and cross-section and longitudinal dimensions of stack a point exists where the raw or wet material will not be supported by the current; but to be supported at this point the material must be partially finished or dried. It follows that as the area of cross-section of the stack increases as the stack ascends the vertical force or velocity of the current decreases in like proportion, and consequently the higher in the stack that the material is suspended the more completely dried or finished it must be. It will thus be seen that from the point where the current is at first able to suspend the raw or wet material to the top of the stack there is a constant and automatic separation of the finished from the less finished material until the perfectly finished and dry material is delivered at the top entirely free from any of the unfinished portions of the material.

The whirling or spiral course of the current of treating agent produced by the construction shown in Figs. 1, 5, and 6 is useful for causing a greater agitation of the material to be treated and a more thorough commingling of the treating agent with its particles. It is also to be noted that where the current has an upward spiral course the heavier—that is, the moist or unfinished material—will be driven to the outer side of the current and against the walls of the chamber, while the finished or lighter materials will assume an inner position, the wet or unfinished displacing or forcing out of the outer portions of the cur-

rent the material that has become finished or dried, and especially in case where the heating-jacket is used the heavier or wet material is kept in contact with the hot walls of the stack until it becomes dried or finished, when it is immediately displaced by other moist material, since the moist material being heavier will always seek the larger circle and force the dry material away. Thus the spiral current insures the position of the moist material at all times for its most efficient treatment. In this respect the said current may be appropriately termed an "operating agent."

A further regulation of the current of treating agent at the top of the stack may be secured by the proper adjustment of baffle plate or plates—such, for instance, as are shown in Fig. 1. By lowering the rod supporting these plates their peripheries approach the surrounding wall of the stack and restrict the passage therebetween of the treating agent laden with the dry material, such adjustment being made to suit the nature of the material to be treated. Suitable adjustment may also be made between the velocity of the current of heating agent delivered at the bottom of the stack and the rate of feed of material delivered into the stack, the former by controlling the speed of the blower or fan 2, as above described, and the latter either by similarly regulating the speed of the revolving table 4 or changing the angular position of the deflecting-blade 5, or both. Thus with due regard to the dimensions of the stack the feed of material and the velocity of the current of treating agent may be exactly adjusted to the work to be done in the most efficient way.

As already stated, the dry material is carried from the top of the stack through pipe 17 to the cyclone-separator 18, where the dry material falls through the treating agent to the bottom of separator 18 and is carried off by the conveyer 19. The treating agent passes out of separator 18 through pipe 20 to the dust-receiver 21, where any particles of material that still remain in the treating agent are collected and carried off by the conveyer 22. The treating agent is then conducted from the dust-receiver 21 through pipe 23 to heater 24, thence through pipe 25 to blower or fan 2 and back to stack 1. In the case where moisture is to be carried off from the material a portion of the treating agent may be allowed to escape at exit 26, only a portion being taken back to the heater 24, where fresh air or other treating agent is added through the inlet 27.

Of course the stack 1 in whatever combination used, and whether for drying, chemical treatment, or other purpose, may be heated, as shown and described in connection with Figs. 1 and 5, and as the material, especially where given a spiral motion, comes in very intimate contact with the interior surface of the stack the heat will be trans-

mitted to it with great efficiency and a large product obtained. It is to be understood also that any of the feed devices shown or others may be used in any of the systems 5 shown or the equivalents of such systems, and, further, that any of the various baffle and separating devices or their equivalents herein shown and described may be used in any of the systems or their equivalents herein 10 disclosed.

As indicated in the first paragraph of the specification, my invention is intended for the drying of moist material or for chemically treating material, and in my use of the 15 term "treating" in the following claims I mean thereby either the drying of material or the causing of some chemical change in the material treated, as distinguished from the mere mechanical separation of different 20 particles of a heterogeneous mass, such as the separation of wheat from chaff or any heavier particles from lighter particles.

What I claim is—

1. In an apparatus for treating material, a 25 series of chambers forming a closed circulatory system including a treating-chamber, means for continuously feeding into said chamber the material to be treated, means for causing an upward current of an agent for 30 treating the material in said chamber and also for transporting the material upwardly through said chamber as it approaches the finished state.

2. In an apparatus for treating material, a 35 series of communicating chambers forming a closed circulatory system, one of which is a treating-chamber, means for feeding material into the treating-chamber, and means for causing an upward circulation through said 40 chamber of an agent to treat said material and so as to separate the finished from the unfinished material.

3. In an apparatus for treating material, a 45 series of communicating chambers forming a continuous closed circulatory system, means for continuously feeding into one of said chambers material to be treated, means for causing an upward circulation of a treating 50 agent through said chamber so as to operate upon and transport the material, and means for separating the treated material from the said agent.

4. In an apparatus for treating material, a 55 series of communicating chambers forming a continuous closed circulatory system, means for continuously feeding into one of said chambers material to be treated, means for causing a circulation through said series of 60 an agent for operating upon and transporting the material and so as to cause the separation of the treated material from the operating agent.

5. In an apparatus for treating material, a 65 series of communicating chambers forming a continuous closed circulatory system, means for continuously feeding into one of said chambers material to be treated, means for

causing an upward circulation through said chamber of an agent for operating upon and transporting the material, means for impart- 70 ing heat to the operating agent and means for causing the separation of the treated material from the operating agent.

6. In an apparatus for treating material, a 75 series of communicating chambers forming a closed circulatory system, a treating-chamber, having its longitudinal extension vertically disposed, as one of said series, means for feeding material into the treating-chamber and means for causing a circulation 80 through said chamber of an agent which passes upwardly through the treating-chamber to treat said material and to separate the finished from the unfinished material.

7. In an apparatus for treating material, a 85 series of communicating chambers forming a closed circulatory system, a vertical stack as one of said series of chambers, means for continuously feeding into said stack material to 90 be treated and means for causing an upward circulation through said stack of an agent to operate upon and transporting the material.

8. In an apparatus for treating materials, a series of communicating chambers forming 95 a closed circulatory system, a vertical stack as one of said series of chambers and means for causing an upward spiral circulation through said stack of an agent for operating 100 upon and transporting the material.

9. In an apparatus for treating materials, 100 a series of communicating chambers forming a closed circulatory system, a vertical stack as one of said series of chambers, means for causing a spiral circulation through said stack 105 of an agent for operating upon and transporting the material and means for imparting heat to the walls of the stack.

10. In an apparatus for treating materials, a series of communicating chambers forming 110 a circulatory system, a treating-chamber as one of said series, means for circulating an agent for treating material in said chamber and also for transporting the material 115 through said chamber as the material approaches the finished state, means for causing the circulation of said agent and means for replenishing the circulating agent.

11. In an apparatus for treating material, the combination of a treating-chamber vertically disposed of increasing area of cross- 120 section toward its upper extension and contracted at the top, a conductor leading from the contracted top, a separating-chamber connected with the treating-chamber by said conductor, conducting means leading from the 125 separating-chamber back to the lower part of the treating-chamber, means for inducing an upward current of treating agent in the treating-chamber and means for continuously feeding material to be treated into said agent. 130

12. In an apparatus for treating material, the combination of a treating-chamber vertically disposed of increasing area of cross-section toward its upper extension and con-

- tracted at the top, means for inducing an upward current of treating agent through said chamber, means for feeding material to be treated into said agent and a series of separating-chambers connected between the contracted top and the lower portion of the treating-chamber so that the treating agent may circulate from the treating-chamber through the separating-chamber back to the treating-chamber.
13. In an apparatus for treating material, the combination of a stack, a blower and a feed, said elements being so proportioned and adjusted relatively as to afford means whereby an upward current of treating agent is induced in the stack, the material fed into said current and suspended therein during treatment and until it becomes finished and then transported by the agent.
14. In a drying apparatus, the combination of a stack, a blower and a feed, said elements being so proportioned and adjusted relatively as to afford means whereby an aeriform current of decreasing vertical velocity is induced through moist material to suspend the same until dried.
15. In an apparatus for treating material, the combination of a stack of increasing area of cross-section toward its upper extension and then contracted at the top, means for inducing an upward current of treating agent therethrough, and means for feeding material to be treated into said stack, so that the same shall be continuously suspended by the treating agent until finished.
16. In an apparatus for treating material, the combination of a stack of increasing area of cross-section toward its upper extension and then contracted at the top, means for inducing an upward current of treating agent therethrough, means for feeding material to be treated into said stack, a separating-chamber and a conductor leading thereto from the upper restricted portion of the stack.
17. In an apparatus for treating material, the combination of a stack of increasing area of cross-section toward its upper extension and then contracted at the top, means for inducing an upward current of treating agent therethrough, means for feeding material to be treated into said stack, a separating-chamber, a conductor leading thereto from the upper restricted portion of the stack and means for conducting the treating agent from the separating-chamber back to the stack.
18. A drying apparatus comprising a vertical stack increasing in diameter with its height, means for causing an upward spiral circulation through said stack of a treating agent whereby the material to be treated is suspended in said agent, and is transported upwardly through said stack as it approaches the finished state.
19. A drying apparatus comprising a vertical stack increasing in diameter with its height, means for causing an upward spiral circulation through said stack of a treating agent whereby the material to be treated is suspended in said agent and the finished material separated from the unfinished material and transported from the stack.
20. In an apparatus for treating material, which changes in specific gravity through treatment, means for inducing an upward spiral aeriform current of decreasing vertical velocity to cause the finished material to be selected from the unfinished material and discharged and means for introducing the material into said current.
21. A drier comprising a treating-stack, a separator, a heater, and a blower forming together a circulatory system, means for feeding the material to be treated into said stack, and means for inducing a treating-current to suspend the material during treatment.
22. A treating-stack, means near the bottom thereof for introducing a spiral current of the operating agent, means for introducing the material to be treated into said agent and a baffle near the exit of said stack.
23. A treating-stack, means near the bottom thereof for introducing a spiral current of the operating agent, means for introducing the material to be treated into said agent, and an adjustable baffle near the exit of said stack.
24. A drier-stack gradually increasing in diameter with its height, a tapering enlargement near the exit of said stack, and a baffle secured adjacent said exit.
25. A drier comprising a vertical stack, means for causing the circulation through said stack of an operating agent, a port in said stack, a rotating table, and a blade supported in proximity to said table for deflecting the material to be treated through said port.
26. A drying apparatus comprising a vertical stack increasing in diameter with its height, means for causing an upward spiral circulation through said stack of a treating agent whereby the material to be treated is suspended in said agent and is transported upwardly through said stack as it approaches the finished state and means for imparting heat to the treating agent.
27. Means for inducing an aeriform current of decreasing vertical velocity through moist material for the purpose of drying the same, exit means for discharging the material when dried, a table-feed for delivering the moist material into the current through an intake-opening, and means for maintaining a superimposed mass of material as a seal for the material intake-opening.
28. The combination of an upwardly-extending stack having increasing area of cross-section in its upper extension, regulatable means for inducing an aeriform current into said stack, a table-feed consisting of a receptacle having a revolving table at its bottom, a fixed blade for cooperating therewith arranged to encounter the material brought to it by the revolving table to deflect the same

into the stack as regulatable means for introducing the material to be treated.

29. In an apparatus for treating material, the combination of a stack of increasing area of cross-section toward its upper extension, means for inducing an upward current of treating agent therethrough, means for feeding material to be treated in said stack, a separating-chamber connected with said stack for separating the finished material from the treating agent and conveying means connected therewith for carrying off the finished material.

30. In an apparatus for treating material, the combination of a stack of increasing area of cross-section toward its upper extension, means for inducing an upward current of treating agent therethrough, means for feeding material to be treated in said stack, a separating-chamber connected with said stack for separating the finished material from the treating agent, conveying means connected therewith for carrying off the finished material and conducting means connected with the separator for returning the treating agent back to the stack.

31. In an apparatus for treating material, the combination of a stack of increasing area of cross-section toward its upper extension, means for inducing an upward current of treating agent therethrough, means for feeding material to be treated in said stack, a separating-chamber connected with said stack for separating the finished material from the treating agent, conveying means connected therewith for carrying off the finished material and a conductor and heater connected between the separating-chamber and the stack for heating and returning said agent to the stack.

32. In an apparatus for treating material which changes in specific gravity during treatment, means for inducing an upward spiral aeriform current of decreasing vertical velocity to cause the finished material to be selected from the unfinished material and automatically discharged, means for introducing the material into said current, and exit means below the current for removing the material that may fall past the influence of the current.

33. In an apparatus for treating material which changes in specific gravity during treatment, means for inducing an upward spiral aeriform current of decreasing vertical velocity to cause the finished material to be selected from the raw material and automatically discharged, means for introducing the material into said current, a chamber below said current for receiving and containing the material that may fall past the influence of the current, and exit means connected therewith for removing the same.

34. In an apparatus for treating material which changes in specific gravity during treatment, the combination of means for inducing

a spiral aeriform current through said material to cause the separation of the finished from the unfinished material, means for feeding material into the current through an intake-opening and means for maintaining a superimposed mass of material as a seal for the intake-opening.

35. In an apparatus for treating material which changes in specific gravity during treatment, a chamber whose cross-section increases with its height, means for heating the walls of said chamber, means for inducing into said chamber an upward spiral aeriform current to keep the material against the heated walls of the chamber.

36. In an apparatus for treating material, the combination of a treating-chamber, regulatable means for introducing into the chamber material to be treated, means for inducing an upward current of treating agent so as to continuously suspend the whole mass of material in the chamber during the period of treatment and to transport the same as it becomes treated, and a separating-chamber connected with the treating-chamber for receiving the transported material and separating the same from the treating agent.

37. In an apparatus for treating material, the combination of a treating-chamber, regulatable means for introducing into the chamber material to be treated, and means for inducing an upward spiral current of treating agent to suspend the whole mass of material in the chamber during the period of treatment and transport the same as it becomes treated.

38. In an apparatus for treating material, the combination of a treating-chamber, means for introducing into the chamber material to be treated, regulatable means for inducing an upward current of treating agent so as to continuously suspend the material in the chamber during the period of treatment and to transport the same as it becomes finished, and a separating-chamber connected with the treating-chamber for receiving the transported material and separating it from the treating agent.

39. In an apparatus for treating material, the combination of a treating-chamber, means for introducing into the chamber material to be treated, regulatable means for inducing an upward spiral current of treating agent to suspend the material in the chamber during the period of treatment and to transport the same as it becomes finished.

40. In an apparatus for treating material, the combination of a treating-chamber, regulatable means for introducing into the chamber material to be treated and regulatable means for inducing an upward current of treating agent so as to continuously suspend the material in the chamber during the period of treatment and to transport the same as it becomes finished, a separating-chamber connected with the treating-chamber for receiving the transported material and separating

it from the treating agent and conducting means for returning the treating agent back to the treating-chamber.

41. In an apparatus for treating material, the combination of a treating chamber, regulatable means for introducing into the chamber material to be treated and regulatable means for inducing an upward spiral current of treating agent to suspend the material in the chamber during the period of treatment and to transport the same as it becomes finished.

42. An upwardly-extending chamber increasing in area of cross-section in its upward extension, means for introducing into said chamber a spiral aeriform current, means for introducing the material to be treated into the chamber above the current-intake, means for applying heat to the material while in the current, and means for withdrawing the finished product therefrom.

43. An upwardly-extending chamber increasing in area in cross-section in its upward extension, means for inducing an aeriform current tangential to the wall of the chamber to give it a spiral direction, and means for introducing the material to be treated into the chamber above the current-intake, and means for withdrawing the finished product therefrom.

44. The combination of an upwardly-ex-

tending chamber having increasing area of cross-section in its upper extension, regulatable means for inducing an aeriform current into said chamber, regulatable means for introducing material to be treated into said current, an exit above the material intake-point for discharging the dry product, a cyclone separator connected with said exit, a heater connected with the separator and also with said chamber, and a valve-controlled exit in the system between the separator and the heater adapted to open to the outer atmosphere.

45. The combination of an upwardly-extending stack having increasing area of cross-section in its upward extension, regulatable means for inducing an aeriform current into said stack, regulatable means for introducing material to be treated into said current, an exit above the material intake-point for discharging the finished product, a cyclone separator connected with said exit, a heater connected with the separator, conducting means connecting the heater with the stack and valve-controlled inlet means connected with the heater.

EDWARD N. TRUMP.

Witnesses:

GEORGE ROOT,
W. M. HALL.