

Aug. 25, 1925.

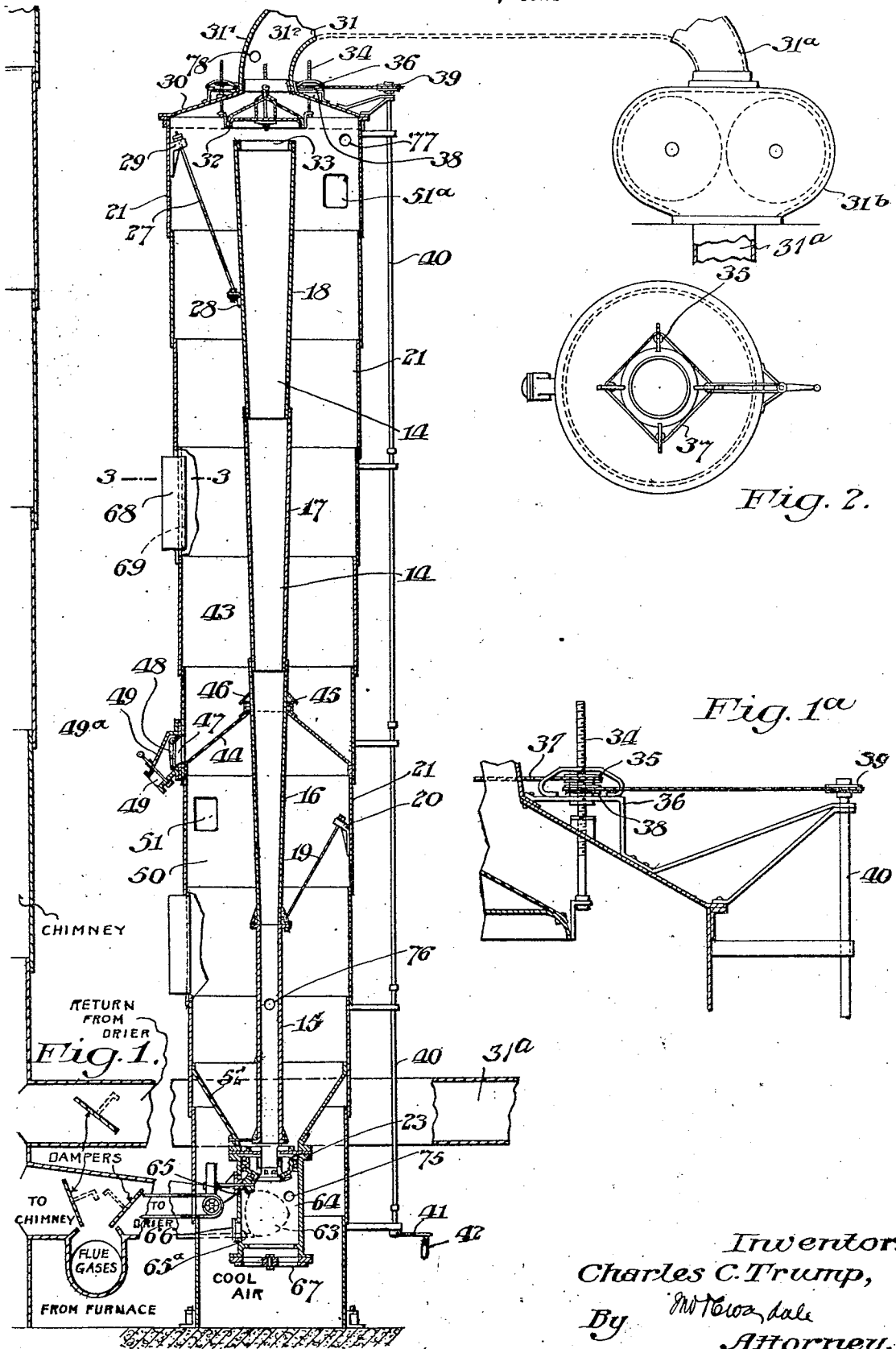
1,550,992

C. C. TRUMP

DRIER

Filed Dec. 23, 1921

3 Sheets-Sheet 1



Inventor:
Charles C. Trump,
By *Wm. T. W. Dale*
Attorney.

Aug. 25, 1925.

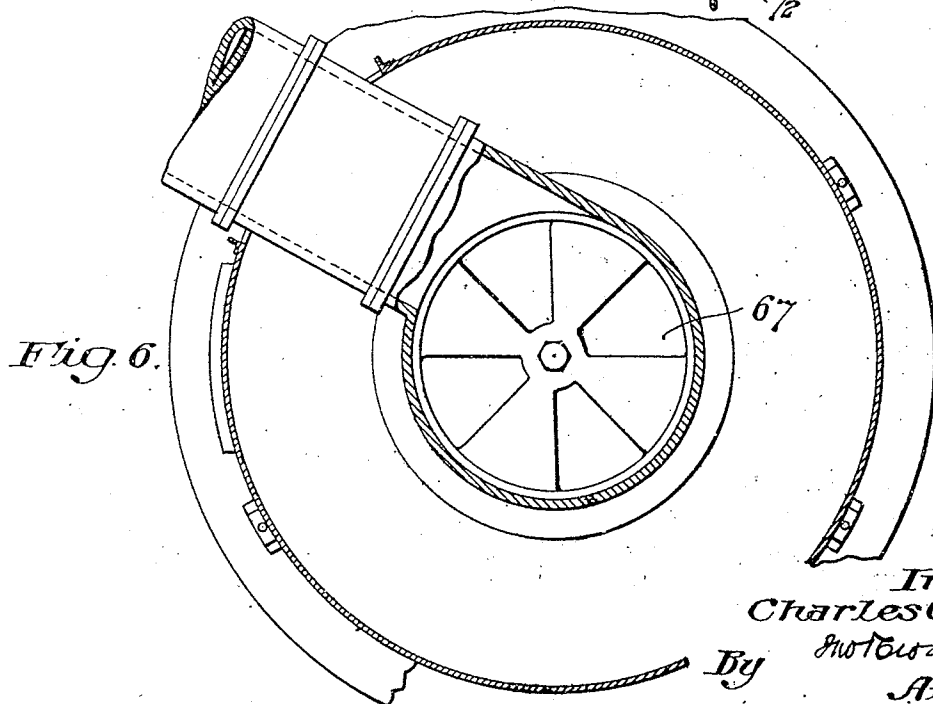
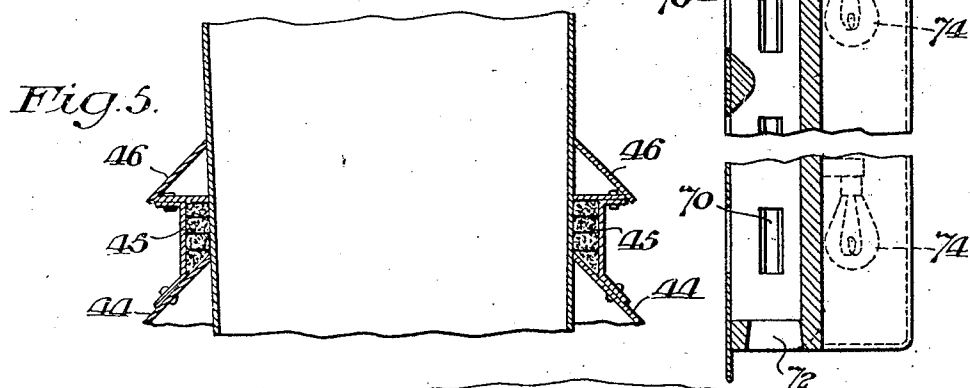
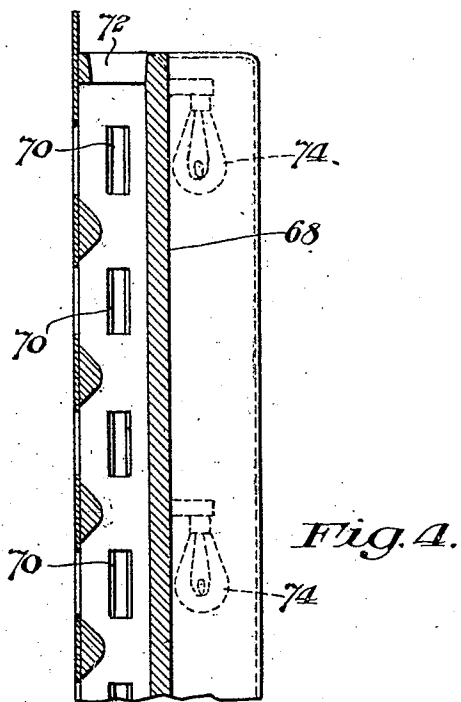
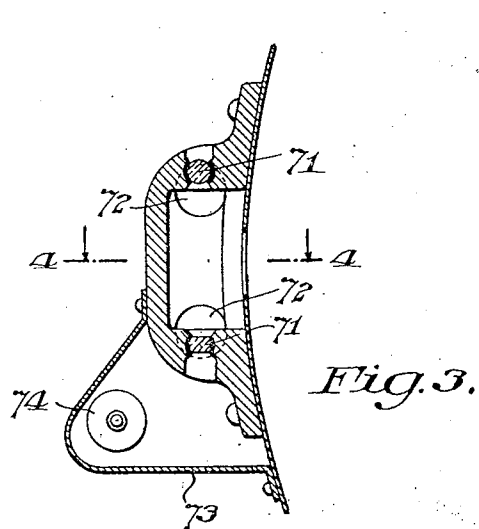
1,550,992

C. C. TRUMP

DRIER

Filed Dec. 23, 1921

3 Sheets-Sheet 2



Inventor:
Charles C. Trump,
By *Wm. C. Wadale*
Attorney.

Aug. 25, 1925.

1,550,992

C. C. TRUMP

DRIER

Filed Dec. 23, 1921

3 Sheets-Sheet 3

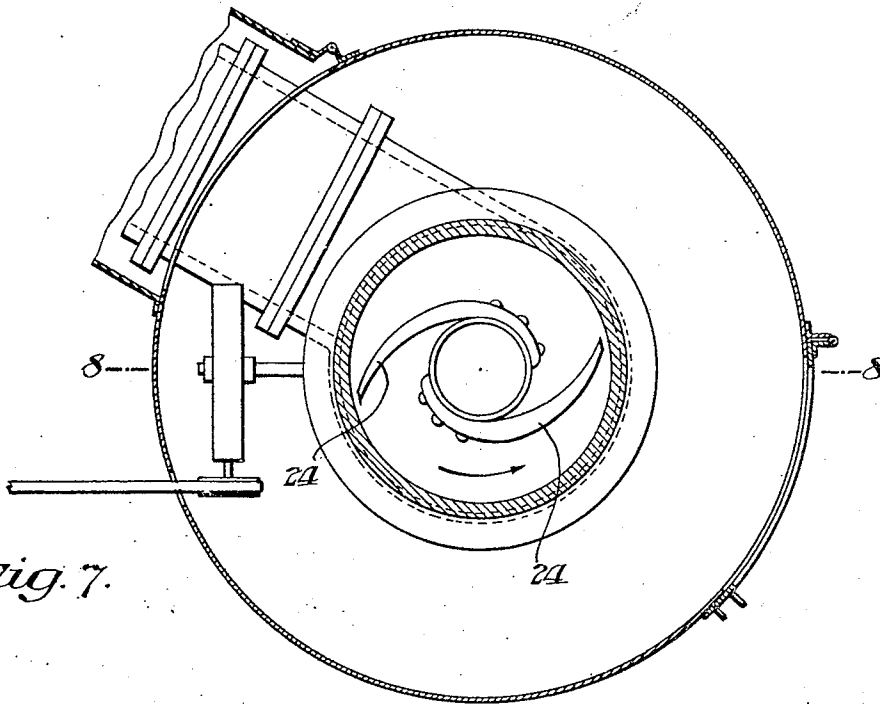


Fig. 7.

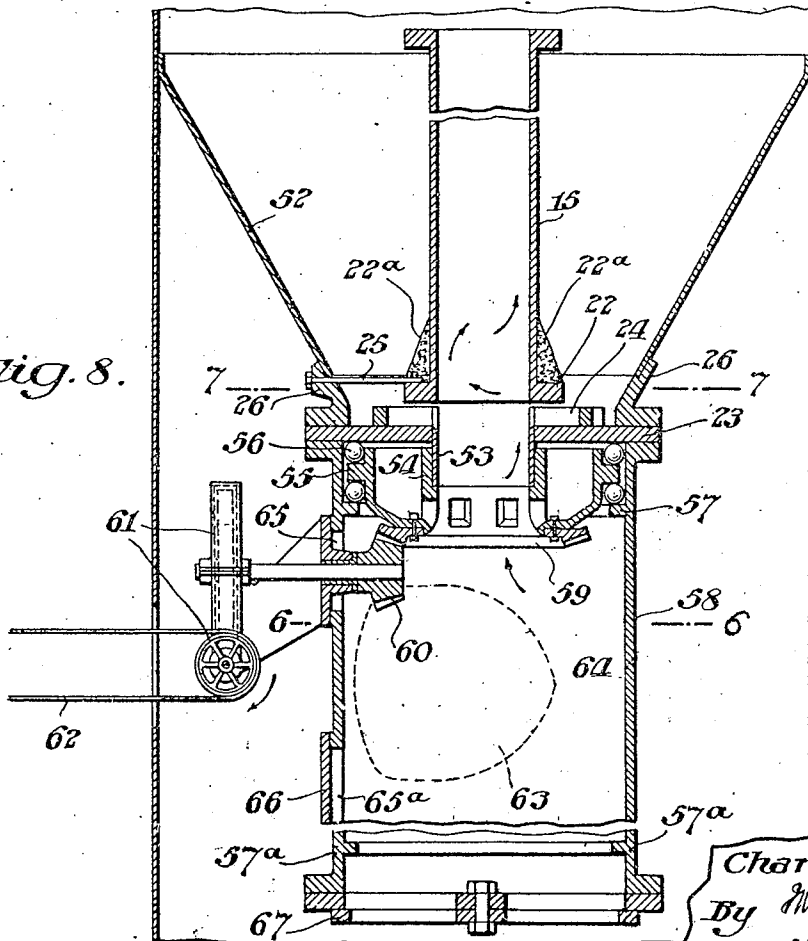


Fig. 8.

Inventor.
Charles C. Trump,
By *Wm. Cowdell*
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES C. TRUMP, OF SYRACUSE, NEW YORK.

DRIER.

Application filed December 23, 1921. Serial No. 524,401.

To all whom it may concern:

Be it known that I, CHARLES C. TRUMP, a citizen of the United States, residing at Syracuse, in the county of Onondaga, State of New York, have invented a new and useful Drier, of which the following is a specification.

My invention relates to improvements in driers. The object is to provide an improved method and means for drying fine materials such as fine coal, or similar substance.

The invention is especially applicable for the utilization of the waste heat derived from the products of combustion, as the fluid drying-agent.

A treating agent consisting of hot gases from the base of a stack or from furnace flues is especially desirable as it is usually a waste product and does not contain enough oxygen to support combustion which, with fine dust might result in explosions.

Excess air or that mixed with such gases for cooling them to a proper temperature may be limited to amount sufficient to support violent combustion.

The invention comprises an improved method of moving the drying agent or medium so as to maintain the proper velocity of the same at the desired points in its path of travel, reduce the temperature at which evaporation is complete and to prevent the escape of dust from the apparatus by keeping as much as possible of it under suction rather than under pressure with respect to atmosphere.

The invention comprises improved means for storing the raw or wet material in convenient proximity to the drying agent so that the same shall be in a measure influenced thereby before its actual introduction into the current of said drying agent.

The invention comprises improved means for collecting the dried or finished product also in convenient proximity and so that the same shall be to a certain extent under the influence of the heat derived from the drying agent.

The invention includes improved air throttling devices and control which are especially made feasible by the suction.

The invention comprises improved means for adjustable suspension of the stack for

carrying the medium and material under treatment and also adjustable means for varying the position of the separating baffle.

The invention includes improved means for feeding the material into the current of drying agent, and improved means whereby the level of the material treated may be observed, said observation means covering a substantial range in variation of level.

The invention comprises the provision, in combination with other elements, of gate or check valves adapted to maintain the suction, but to open promptly upon the occurrence of abnormal pressures within the stack.

The invention also comprises various improvements in method of operation and details of construction.

Referring to the drawings which illustrate merely by way of example, suitable means for effecting the invention;

Fig. 1 is a vertical section.

Fig. 1^a is a fragmentary detail in elevation on an enlarged scale.

Fig. 2 is a plan view.

Fig. 3 is a horizontal section on line 3—3 of Fig. 1 on an enlarged scale.

Fig. 4 is a vertical section on line 4—4 of Fig. 3.

Fig. 5 is a fragmentary vertical section on an enlarged scale showing a detail of construction.

Fig. 6 is a horizontal section on line 6—6 of Fig. 8.

Fig. 7 is a horizontal section on line 7—7 of Fig. 8.

Fig. 8 is a vertical section on line 8—8 of Fig. 7.

Figs. 6, 7 and 8 are on an enlarged scale.

Similar numerals refer to similar parts throughout the several views.

As shown in the drawings the drying apparatus comprises a vertical stack which, broadly speaking, increases in diameter with its height and is provided with 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 is separated from the unfinished material and from the treating agent.

In the example given, the vertical stack consists of the sections 15, 16, 17 and 18.

Section 15 may be of the same cross-section throughout its length and is termed "the speed pipe" and is suspended by a number of bolts or rods, such as 19, from brackets such as 20 secured to the tubular casing 21 which surrounds, supports and encloses the stack. The lower end 22 of section 15 is spaced a short distance above the top surface of table 23 in order to leave room between said lower end and the table top for the passage of the knives or scrapers 24. The said lower end 22 of section 15 is also maintained in proper central position by means of bolts such as 25 connected to brackets such as 26. The section 16 of the stack is of uniform taper formation, the lower end of which rests upon, and is secured to the flange of upper end of section 15. Sections 17 and 18 are also similarly tapered, the small lower end of 17 fitting within the upper end of 16, while the upper end of 17 receives the smaller end of 18. The formation of these sections 16, 17 and 18 is such as to constitute a single stack of uniform increase in cross-section dimension throughout its length. These several sections are properly supported where necessary by tie rods or bolts, such as 27, connected by brackets, such as 28, to the stack section and brackets such as 29 to the casing 21. The tubular casing 21 is provided with a cover 30 at the top thereof having an opening 31 for carrying off the drying agent after the same has been partly separated from the material treated. This opening 31 is preferably connected by means of the pipe 31^a to a dust collector (not shown) and thence an exhaust fan or blower 31^b. A baffle 32 is provided over the open mouth 33 of stack 14. This baffle is made adjustable by mounting the same on the threaded rods 34 which project through the top cover 30. Sprocket wheels or pulleys 35 are threaded on these rods 34, and are adapted to bear upon suitable abutments such as 36 connected with cover 30. These wheels 35 are operatively connected by a sprocket chain 37 so that they will all turn together. One of these rotating elements 35 is also connected to a sprocket or pulley 38, belted or otherwise operatively connected to a sprocket or pulley 39 on shaft 40, having at its lower end the crank 41 provided with the handle 42, so that by turning the shaft 40 in one direction or the other the baffle 32 may be lowered or raised as required.

The tubular casing 21 is divided into separate chambers in the following manner.

The upper chamber or dry bin 43 is adapted to receive the finished material, and is provided with the sheet metal bottom 44. This bottom 44 is provided with a central opening for the stack 14 and a yielding heat resisting packing 45 as shown in Figs. 1 and 5. This packing permits a relative

movement between the stack and the bottom wall 44, due to expansion and contraction upon variations in temperature. A conical roof formation 46 is also provided around the stack above the joint 45 to prevent material from lodging. At the outer lower periphery of the bottom 44 is provided an outlet port 47 having an outwardly movable flap valve 48 adapted to be held closed by gravity and suction within the chamber or bin 43. This valve 48 is preferably cased within the discharge nozzle 49 which has a slidable stop gate 49^a and is connected with the port 47. Beneath the bottom 44 is the wet bin 50 for receiving the material which is to be treated. Material may be introduced to this bin in any suitable way, as for instance through the port or door 51. This chamber or wet bin 50 is provided with the funnel shaped bottom 52, the outer margin or periphery of which is connected to the walls of the casing 21 while the inner lower margin is connected by a flange or bracket 26 to the table 23. This table 23 has a central opening registering with the bore of pipe 15. The periphery of the flange of pipe 15 is such as to maintain the natural slope of the material within the margin of the opening in table 23, so that the material will only discharge into said opening by the action of the knives 24. The upper surface of flange 22, as well as any other flanges or projections which might afford a place of lodgment for material, are preferably provided with an inclined roof, or filled with material, such as 22^a, having a downwardly inclined wall to prevent such lodgment of material. The knives 24, which, by their spiral form are easily adapted to sweep the top of table 23, are connected by means of the collar 53 to the annular formation 54 having the flange 55 operating in the ball bearing 56 supported by the flange 57 of the stationary structure 58. The collar 53 extends through the opening in table 23. To the bottom of the annular body 54 is bolted or otherwise connected, the annular bevel gear 59 meshing with the pinion 60 which is operated by a worm gear mechanism 61 driven by the belt 62 from any suitable source of power. A pipe from flue or other suitable source of hot gases, delivers tangentially through opening 63 to cyclone chamber 64 so that an upward spiral current is created through the speed pipe 15 and the stack 14.

Corresponding openings 65 and 65^a are provided near the ends of cyclone chamber 64 and corresponding bearings 57 and 57^a are provided adjacent thereto. This permits reversing the position of the chamber 64, end for end, and consequently the direction of the spiral flow. Either opening 65 or 65^a is adapted to admit the pinion 60 and its bearing as required, the other opening being covered by the closure 66. Similarly

each bearing 57 and 57^a is adapted to become part of the ball bearing support of structure 54.

At the bottom of chamber 64 is provided an adjustable throttle plate 67 for admitting and varying the introduction of cool or fresh air as required.

At proper points in each bin I have provided level indicators as follows:—

10 A pocket forming casting 68 is bolted or otherwise secured to the wall of the casing 21, in register with a suitable opening or slits 69 provided in said wall. On opposite sides of this pocket forming casting 68 are provided slits or windows 70. In these windows are secured glass rods 71 preferably with two round and two flat sides, the rounded sides being inserted in the walls of the windows with suitable gasket packing such as rubber or asbestos. These castings 68 are preferably provided with openings 72 at top and bottom. These are normally closed by suitable plugs which are removable for purposes of cleaning. Secured to one side of casing 68 is a suitable housing such as 73 within which are provided electric lamps 74. These lamps are preferably of different colors such as green, white and red. The interior of the housing 73 is preferably of white or it may have such reflecting qualities as to cast a substantial illumination through the windows 70. It will be understood that the material is free to flow into the pocket of member 68 up to the natural level of the material in the bin, and consequently only the light of the lamps can be seen through a horizontal pair of windows which are above the level of the material, so that if the order of the colors of the lamps is noted, it will be immediately apparent from the color seen through a pair of horizontal windows what is the level of the material in the bin to which this indicator is connected. It will be understood that such indicators may be placed on different sides and at different levels of the bins as required.

For the further control of the drier operation recording thermometers and pressure gauges should be connected at suitable points, for example, as points indicated at 75, 76, 77 and 78 on Fig. 1. That is to say, there should be pressure and temperature indications, as follows: in the cyclone, in the speed pipe, in the separating chamber and in the discharge pipe from the top. Proper factors applied to these records give accurate indications of velocity and temperature contents at all times, and these, with the measure of material fed, from the calibration of the feeder knives and the count of their revolutions, show the efficiency of the drier under all conditions.

The operation is as follows:—

65 The wet material to be treated is intro-

duced into the wet bin 50 through the opening or port 51, and, by means of the natural slope between the outer periphery of flange at the bottom of pipe 15 and the top of table 23, forms a seal between said bin and the interior of said pipe 15. A current of heated gases is introduced tangentially through opening 63 into the cyclone chamber 64 so as to cause a spiral current flow upwardly through the stack 14. This current preferably is induced by a suction blower or fan connecting with the upper end of said tubular casing 21, the main chimney draft cooperating therewith. The knives or scrapers 24 are rotated to cause the feed of material from the bin through the opening between pipe and table into the upwardly directed spiral current of treating agent. The speed of rotation of the knives is adjusted with respect to the velocity of the current of agent moving upwardly into stack 14, so that only such material is deflected into the path of travel of the treating agent as will be suspended thereby and carried upwardly through the speed pipe 15. As this pipe is of a uniform diameter throughout its length and of a diameter less than that of the balance of the stack, it follows that the highest acceleration and velocity of the agent will be in this pipe. By the time the material has travelled the length of the pipe 15 it will have begun to dry and will thus have lost some of its weight. As the pipe gradually increases in diameter during the balance of its upward extension, it follows that the velocity of the treating agent correspondingly decreases. This decrease of current velocity is proportioned to the decrease in weight of the material, as it dries during its upward travel, so that by the time the material has reached the top of the stack, it is practically dry. By the baffle 32 it is deflected outwardly towards the periphery of the tubular casing 21, and the current of treating agent as it leaves the top of stack 14 and engages the baffle 32 is dispersed downward into the greater area surrounded by the tubular casing, and, to a very large degree, loses its velocity so that a substantial part of the material is no longer suspended therein but falls by gravity to the bottom of the dry bin 42. The treating agent thus separated from the dried material, is carried upwardly through the discharge pipe 31.

The material from the dry bin may be drawn off from time to time or continuously through the discharge nozzle 49, controlled by the flap valve 48 and the slide gate 49. This valve 48 is preferably gravity controlled, and is adapted to automatically close to prevent the breaking of the vacuum in chamber 43, in case the chamber should at any time be without material therein. Ordinarily the material in this bin will keep

the same sealed. This valve 48 is also adapted to open automatically upon the occurrence of abnormal pressure in the bin. Similar relief valves are placed at required points in the apparatus, as for example at 51 and 51^a. These valve controlled ports may at the same time serve other purposes.

By using a suitable blower or exhaust fan connected at or beyond the top of the casing 21, or the separator, the required velocity of the agent throughout the extension of the stack 14 may be at all times maintained. By this means also it is possible to utilize the products of combustion from a furnace or the like without impairing the draft which is ordinarily secured by the stack. In case it should be desirable, it would also be possible to connect a fan or booster between the flue and the cyclone chamber.

By means of the indicators above described it is possible, by observing the light passing through a pair of opposite windows 70, and noting the color of the light showing therethrough, instantly to know the approximate level of the material in either bin.

By means of the temperature and pressure gauges above referred to, it is also possible to make such correlations between temperature, speed of current flow, and feed of material, to secure the most efficient operation of the device.

The temperature of the gases may be kept within proper limits, as for example below the point at which coal loses volatile matter, by admitting more or less cool air through the throttled opening with bottom of chamber 64. This may even be automatically controlled by the temperature controlling means.

What I claim is:—

1. The method of drying material, which consists in utilizing suction caused by the draft of a furnace stack supplemented by a blower to produce an upwardly moving current of treating agent through a path of travel of increasing cross-section, and causing said material to be fed into said path of travel and carried upwardly by said current.

2. The method of drying material, which consists in utilizing suction to produce an upwardly moving current of a heated treating agent through a path of travel of increasing cross-section, causing said material to be fed into said path of travel, causing a separation of dried material from said agent, and causing a collection and storage of said dried material in a region subject to heat derived from the treating agent.

3. The method of drying fine material, which consists in utilizing the action of a treating agent, comprising products of combustion, the normal current movement of which is caused by the draft in the chimney,

and supplementing as required, the normal force derived from the draft of the chimney, to maintain the necessary draft in connection with the combustion.

4. The method of drying fine material, which consists in utilizing the action of a treating agent, comprising products of combustion passing from a furnace to a chimney, the normal current movement of which is caused by the draft in the chimney, and supplementing as required, the normal force derived from the draft of the chimney, to maintain the necessary draft in connection with the combustion.

5. In a drying apparatus, means for utilizing the suction force of the draft of a furnace stack to cause an upwardly moving current of treating agent, and means for feeding the material to be treated into said current, and a regulatable cold air intake below the point of introduction of the treating agent as means for controlling the temperature of the agent as required.

6. In a drying apparatus, means for utilizing the suction force of the draft of a furnace stack to cause an upwardly moving current of treating agent, means for supplementing said suction force as required, and means for feeding material to be treated into said current.

7. In a drying apparatus, means for utilizing a suction force to cause an upwardly moving current of treating agent, means for storing the raw material in a region subject to heat derived from the treating agent, and means for feeding the material to be treated into said current, relatively to its velocity flow.

8. In a drying apparatus, means for utilizing a suction force to cause an upwardly moving current of treating agent, and means for feeding the material to be treated into said current, means for separating dried material from said agent and means for collecting said dried material in a region subject to the heat derived from the treating agent.

9. In a drying apparatus, means for utilizing a suction force to cause an upwardly moving spiral current of treating agent, means for feeding the material to be treated into said current, relatively to its velocity flow, and means for reversing the direction of the spiral flow.

10. In a drying apparatus, means for utilizing a suction force to cause an upwardly moving current of treating agent, means for controlling and regulating a supply of air to said agent at a point below the introduction of the agent, and means for feeding the material to be treated into said current, relatively to its velocity flow.

11. In a drying apparatus, means for utilizing a suction force to cause an upwardly moving current of treating agent,

means for causing the current to take a spiral course comprising a cyclone chamber having a tangential intake, and adapted to be reversed end for end, and means for feeding the material to be treated into said current, relatively to its velocity flow.

12. In a drying apparatus, means for utilizing a suction force to cause an upwardly moving current of treating agent, means for causing the current to take a spiral path comprising a cyclone chamber having a tangential intake, adapted to be reversed end for end and provided with a throttled air intake, and means for feeding the material to be treated into said current, relatively to its velocity flow.

13. In a drying apparatus, the combination of an upwardly extending stack of increasing cross-section, a chamber beneath the lower end thereof, means forming a passage between the chamber and stack, means for connecting the chamber with a heated treating agent, means for utilizing the suction of the furnace chimney for cooperating in causing an upward current through said stack, and means for feeding material to be treated into said passage.

14. In a drying apparatus, the combination of an upwardly extending stack of increasing cross-section, a chamber beneath the lower end thereof, means forming a passage between the chamber and stack, means for connecting the chamber with a heated treating agent, means for utilizing the suction of the furnace chimney in combination with a blower for causing an upward current through said stack, and means for feeding material to be treated, into said passage.

15. In a drying apparatus, the combination of an upwardly extending stack of increasing cross-section, a cyclone chamber delivering to the lower end thereof, means for connecting the chamber with a waste gas supply, means for utilizing the suction of the furnace chimney for causing an upward current through said stack, and means for feeding material to be treated, into said current.

16. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent through the stack, a casing enclosing the stack and comprising therein a material bin surrounding the stack.

17. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent through the stack, a casing enclosing the stack and comprising therein a supply bin for raw material adapted to be fed to the stack.

18. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent through the stack, a casing enclosing

and supporting the stack and comprising therein a supply bin for raw material adapted to be fed to the stack.

19. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent through the stack, a casing enclosing the stack and comprising therein a supply bin for raw material and regulatable means for feeding said material from the bin into the said current.

20. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent through the stack, a casing enclosing the stack and comprising therein a bin for receiving the dried material separated from the agent.

21. In a drying apparatus, the combination of an upwardly extending stack, a conductor for a treating agent delivering near to said chamber, means forming a chamber beneath the lower end of said stack but in communication therewith, suction means for causing an upward current of said agent in said stack, and means for feeding material to be treated into said current.

22. In a drying apparatus, the combination of an upwardly extending stack, a conductor for a treating agent delivering thereto, means for causing an upward current of said agent in said stack, means for feeding material to be treated into said current, and a casing enclosing said stack, providing two bins surrounding said stack, one for raw material to be fed to the current and one for dry material separated from the agent.

23. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, a casing enclosing said stack, providing a material bin surrounding said stack, and means for indicating the level of material therein.

24. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, a casing enclosing said stack, providing a material bin surrounding said stack, and means for indicating the level of material therein, comprising a pocket forming body communicating with the bin and having oppositely disposed windows in a substantially horizontal plane, in combination with a source of light.

25. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, a casing enclosing said stack, providing a material bin surrounding said stack, and means

for indicating the level of material therein, comprising a pocket forming body communicating with the bin and having pairs of oppositely disposed windows in different horizontal planes, in combination with a source of light.

26. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, a casing enclosing said stack, providing a material bin surrounding said stack, and means for indicating the level of material therein, comprising a pocket forming body communicating with the bin and having pairs of oppositely disposed windows, in different horizontal planes, in combination with sources of light differing in color.

27. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, a casing enclosing said stack, providing a material bin surrounding said stack, and means for indicating the level of material therein, comprising a pocket forming body communicating with the bin and having oppositely disposed windows, in a substantially horizontal plane, in combination with a source of light and suitable reflecting surface, within the range of vision through said oppositely disposed windows.

28. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, a casing enclosing said stack, providing a material bin surrounding said stack, and provided with ports and pressure relief closures therefor.

29. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, and means for indicating pressure and temperature of the agent before material is fed thereto, after material is fed thereto, in the region of separation of material from agent, and after said separation.

30. In a drying apparatus, the combination of an upwardly extending stack, means for causing an upward current of treating agent in said stack, means for feeding material to be treated into said current, a casing enclosing said stack, providing two material bins surrounding said stack, and means for maintaining an air-tight movable joint between the stack and the wall separating the two bins.

31. In a drying apparatus, the combination of an upwardly extending stack, means

for causing an upward current of treating agent through the stack, a casing enclosing the stack and comprising therein a material bin surrounding the stack, and means for eliminating projecting ledges for the lodgment of material within the bin.

32. In a drying apparatus, the combination of an upwardly extending stack, a conductor for treating agent delivering near the lower part of the stack, suction means for causing an upward current of said agent in said stack, means for feeding material to be treated into said current, and an adjustable baffle for facilitating the separation of dried material from the agent.

33. In a drying apparatus, the combination of an upwardly extending stack, a conductor for a treating agent delivering near the lower part of the stack, suction means for causing an upward current of said agent in said stack, and means for feeding material to be treated into said current, comprising a table spaced below lower end of stack, having a central opening in substantial register with bore of stack, the margin of the central opening and outer margin of the said lower end of stack, being proportioned relatively to maintain the natural slope of material with the margin of the central opening.

34. In a drying apparatus, the combination of an upwardly extending stack, a conductor for a treating agent delivering near the lower part of the stack, suction means for causing an upward current of said agent in said stack, means for feeding material to be treated into said current, comprising a table spaced below the lower end of the stack, having a central opening in substantial register with the bore of the stack, the margin of the central opening and outer margin of the said lower end of stack, being proportioned relatively to maintain the natural slope of material with the margin of the central opening, and deflecting knives for sweeping the table beneath the lower end of stack.

35. In a drying apparatus, the combination of an upwardly extending stack, a conductor for a treating agent delivering near the lower part of the stack, suction means for causing an upward current of said agent in said stack, means for feeding material to be treated into said current, comprising a table spaced below the lower end of the stack, having a central opening in substantial register with the bore of the stack, the margin of the central opening and outer margin of the said lower end of the stack, being proportioned relatively to maintain the natural slope of material with the margin of the central opening, and spiral knives for deflecting the material from the table through the central opening.

36. In a drying apparatus, the combina-

tion of means for utilizing the normal suction force of a chimney draft in causing an upwardly moving current of treating agent, means for feeding material to be dried into said current, and means for augmenting said normal suction force as required.

37. In a drying apparatus, the combination of means for utilizing the normal suction force of a chimney draft in causing an upwardly moving current of treating agent, means for feeding material to be dried into said current, and means for augmenting said normal suction force to secure the necessary current velocity.

38. In a drying apparatus, the combination of means for utilizing the normal suction force of a chimney draft in causing an upwardly moving current of treating agent, means for feeding material to be dried into

said current, and means for augmenting said normal suction force to maintain the necessary draft in the combustion chamber.

39. In a drying apparatus, the combination of means for utilizing the normal suction force of a chimney draft in causing an upwardly moving current of treating agent, means for feeding material to be dried into said current, and means for augmenting said normal suction force to offset impairment of furnace draft due to the treating process.

40. The method of drying material, which consists in using a treating agent capable of absorbing vapor liberated by its heat, mechanically but not chemically, while said material is suspended in said agent while moving under suction in an upward path of increasing cross-section.

CHARLES C. TRUMP.