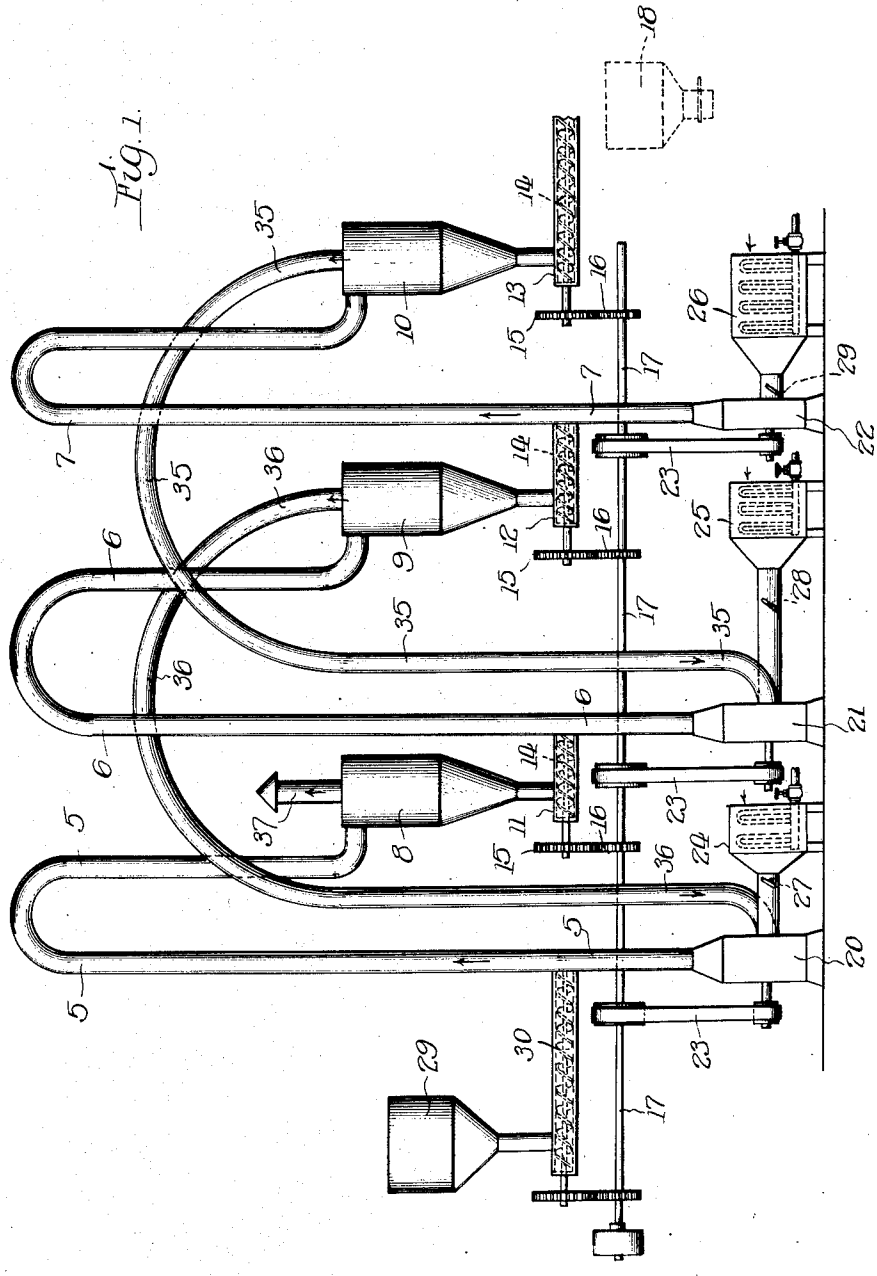
March 10, 1925. 1,528,995

P. A. SINGER

METHOD AND MEANS FOR TREATING MATERIAL

Filed Aug. 28, 1922 2 Sheets-Sheet 1

Fig. 1.



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Inventor:
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By Luther Johns, Atty.

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Fig. 2.

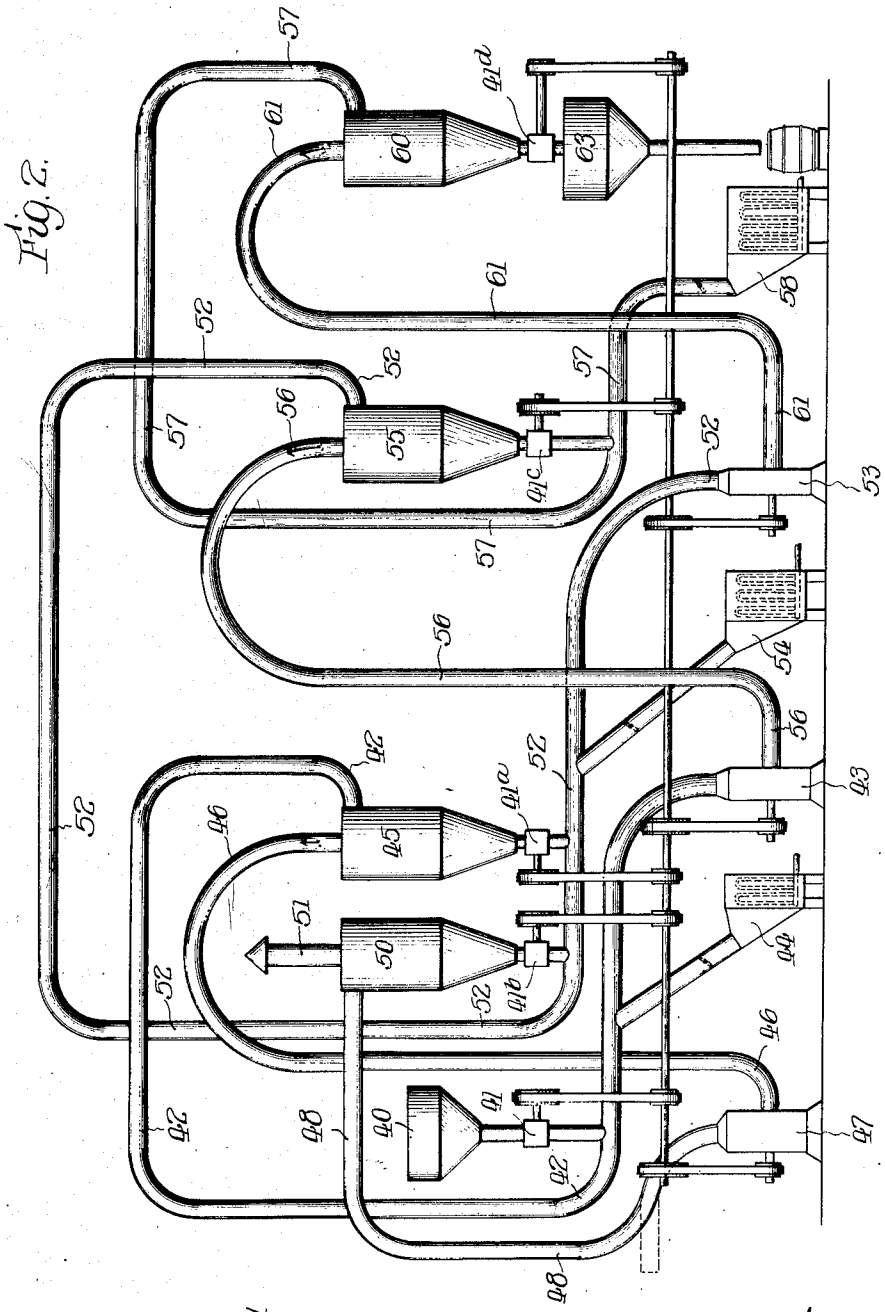
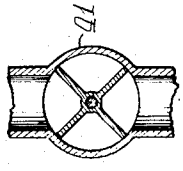


Fig. 3.



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By Luther Johns Atty.

Patented Mar. 10, 1925. 1,528,995

UNITED STATES PATENT OFFICE.

PHILIP A. SINGER, OF GLEN ELLYN, ILLINOIS.

METHOD AND MEANS FOR TREATING MATERIAL.

Application filed August 28, 1922. Serial No. 584,867.

To all whom it may concern:

Be it known that I, PHILIP A. SINGER, a citizen of the United States, residing at Glen Ellyn, Du Page County, Illinois, have invented certain new and useful Improvements Relating to Methods and Means for Treating Material, of which the following is a specification.

The present improvements relate more particularly to methods and means for the treatment of relatively light-weight particles through their association with an aeriform current of a character adapted to effect the desired changes in the material. Such changes may be either physical or chemical. One important use of the present methods and forms of apparatus is to abstract moisture from finely-divided material, and the following description will be made more particularly in connection with that use.

The prime objects of these improvements are to provide a method and means for treating such material, for instance drying it, rapidly and effectively, and through instrumentalities of a simple kind, and which are not likely to get out of order; to provide a method and means for the purposes described which do not call for peculiar niceties of adjustment of forces employed or of relative quantities of materials or of the aeriform current used, and which improved method and means are therefore capable of effective use throughout a wide range of differences in the relative characters of substances being dried and of other elements or features of practice, to the end that supervision and regulation of the method and means during the treating operation are simplified; to provide a method and means by which a relatively great quantity of material may be treated in a given space of time, and without any substantial loss of the material, and also at relatively low cost. Still other objects and advantages will appear hereinafter.

In the accompanying drawings which form a part of this specification, Figure 1 is a side elevation of means constituting a treating system according to these improvements; Fig. 2 is a similar view of another system embodying the improvements; and Fig. 3 is an enlarged fragmentary sectional view of any one of the material-feeding valves shown in Fig. 2.

Referring to Fig. 1 the system there shown includes first three tubular treating members, pipes or conduits 5, 6 and 7 each of which is vertically disposed throughout a materially large part of its linear extent. Since the material being treated is carried forward in an aeriform current such vertical disposition of the pipes 5, 6 and 7 is preferable since thereby the material is carried much more freely and its tendency to adhere to the pipes is reduced to the minimum.

At the rear ends of the pipes 5, 6 and 7, having reference to the direction of travel of the material, are separators or collectors 8, 9 and 10 respectively. These collectors, as illustrated, are to be understood as being of the "cyclone" type, in which the current enters at the top and on a tangent with the curve of the collector body and is thereby made to take a circuitous path within the collector, the material carried by the current being thrown outwardly against the body walls through so-called centrifugal force and dropping to the bottom of the collector through gravitational action.

Associated with the collectors 8, 9 and 10 are feeding devices 11, 12 and 13 respectively, each of which is shown as including a spiral vane 14 rotated in a casing by a gear 15 meshing with another gear 16 on the driving shaft 17. The feeding devices 11, 12 and 13 are what are ordinarily known as screw conveyers, and their function in each instance is to carry forward the material from a collector and to discharge it positively into another pipe for further treatment while providing against the backblowing of material in the conveyer. Thus the feeding device 11 discharges the material into the treating pipe 6 and the conveyer 12 discharges it into the treating pipe 7. The conveyer 13 may discharge the material completely treated into a hopper, as 18, from which it may be drawn for further handling, or the conveyer 13 may discharge the material into another treating pipe similar to pipe 6 or pipe 7, should it be desired to add another unit to the device for a particular purpose.

Each of the treating pipes 5, 6 and 7 has its front end in communication with a blower 20, 21 and 22 respectively. These blowers may be of any approved form and have as their function the provision of an aeriform current within the pipes 5, 6 and 7 traveling toward the respective collectors.

The blowers are shown as being operated by respective belts 23 from pulleys on the main shaft 17.

Since these improvements are being described in connection with the drying of finely-divided material I have shown in the drawings means for supplying preheated air to the pipes 5, 6 and 7. The heater 24 is shown as having two coils of steam pipes therein and as being in communication with the blower 20. The heater 25 is shown as having three steam coils therein and as communicating with the blower 21. The heater 26 is shown as having four steam coils therein, and this heater is in communication with the blower 22. A simple valve 27, 28 and 29 of the damper type controls the intake of freshly-heated air at the blowers respectively.

The material to be treated is placed in the hopper 29 and is fed forward positively by the screw conveyor 30 into the first treating pipe of the series, namely pipe 5, and as a continuous operation, in all respects after the manner of the action of the screw conveyors 11, 12 and 13, so that as long as material continues to be supplied to the hopper 29, the mechanism being also otherwise continuously operated, the drying or other treating process will continue.

From the cyclone collector 10, an exhaust pipe 35 leads backward, (having reference to the direction of the movement of the main body of the material through the system) and discharges into the blower 21. Similarly from the collector 9 a pipe 36 extends rearward and discharges into the blower 20. Accordingly a current passing out of either of the collectors 9 and 10 goes back into the system and at such a place that any of the finely-divided material which does not happen to become separated out in either of the collectors 9 and 10 at any time is again carried to a collector.

Since the material which may escape from collector 10 through pipe 35 discharges into blower 21 such material passes through pipe 6 to collector 9, and if some of it should still fail to be collected and should pass with other uncollected material from collector 9 through the pipe 36 it would be brought into contact with the more moist material issuing into the pipe 5 from the supply feed or conveyor 30 and be so comingled therewith as to become somewhat dampened whereby the likelihood of its escape from the collector 8 is reduced substantially to zero.

The particles of material in the pipe 5, being only partially dried therein, are still heavy proportionately to their respective sizes when the material reaches collector 8, and therefore there is substantially no likelihood of the escape of any of it from collector 8, and the air current leaving the system may be discharged into the open air through the exhaust pipe 37 from the first collector of the series.

Since the air discharged into blower 20 through exhaust pipe 36 was previously heated and since the air discharged into blower 21 through pipe 35 was previously heated I have indicated two, three and four steam coils in the heaters 24, 25 and 26 respectively to indicate that the freshly heated air introduced through the heaters respectively may be less from the first of the series to the last. It will be noted also that the capacity of the blowers 20, 21 and 22 is indicated as being greater from the first of the series to the last. This latter provision is made because all of the air taken in at the several heaters passes through blower 20, and all of the air passing through heaters 25 and 26 enters blower 21, while only the air passing through heater 26 enters blower 22.

The provision of a larger blower for the first treating pipe of the series, while maintaining the diameter of pipe 5 the same as that of pipes 6 and 7, indicates that the velocity of the aeriform current in pipe 5 is greater than that of the current in pipe 6 and that the velocity in pipe 6 is greater than that in pipe 7. This provision is important in view of the fact that the material being treated in pipe 5 is relatively heavy proportionately to the size of the particles and a greater velocity is necessary to carry it forward. In pipe 6 the requirement as to velocity is not so great as in pipe 5, the material being much drier in pipe 6, and in treating pipe 7 the velocity requirement is still less since the material is still much more dry therein.

In describing briefly further the operation of the method and means according to Fig. 1, let us assume that some such substance as wet starch is continuously being supplied to the hopper 29 and that the main shaft 17 is being continuously rotated and also that steam for the heating coils is continuously being supplied to the heaters. The wet material is partially dried in the first treating pipe 5 through the effect of the heated air current therein, such air having the capacity for absorbing moisture. The partially dried material is collected by collector 8 and is continuously fed forward into treating pipe 6 having an independent current of heated air which carries the material forward, further drying it the while. From collector 9 the material is again fed forward into a treating pipe 7, having another independent current and in which the material is carried to collector 10, from which it may be discharged completely dried.

Referring now to Fig. 2, the system there illustrated has various features in common with that of Fig. 1, but it illustrates, among

other things, how more positive suction from collectors may be obtained and also how suction alone may be utilized in instances instead of pressure for producing the current. Since the various mechanical parts will be readily understood from the drawings taken in connection with previous description the method and apparatus of Fig. 2 may be described briefly by tracing out the course of the air currents and of the material.

Let us assume, then, that the material is continuously being supplied to hopper 40 from which it is fed through a rotary feed or valve device 41 to treating pipe 42. An enlarged cross-section of the valve device 41, or of any of the other valves 41^a, 41^b, 41^c, and 41^d, is given in Fig. 3, from which it will be noted that a quantity of the material will be discharged through the device without permitting an interfering quantity of air to pass along therewith. Such valves or feeding devices are well known.

The pipe 42 receives current under pressure from the blower 43, and also heated air from the heater 44, such heated air being drawn into the system. The current and partially dried material within pipes 42 enter collector 45 and the air passes out through the exhaust pipe 46 which leads to blower 47. From blower 47 the air and any uncollected material therein pass through pipe 48 to collector 50 and the air is finally discharged through exhaust pipe 51.

The material separated out by collectors 45 and 50 passes through feeding devices 41^a and 41^b into the treating pipe 52 which receives a supply of air under pressure from the blower 53 and also a fresh supply of heated air from the heater 54. The pipe 52, mostly under vacuum, leads to collector 55 and an exhaust pipe 56 leads from that collector to blower 43. Any uncollected material from collector 55 therefore passes back first to collector 45, and if any thereof should fail of collection in collector 45 it would pass to collector 50 and finally come again to collector 55.

From collector 55 the material passes through the feeding device 41^c into pipe 57 which receives a fresh supply of heated air through the heater 58. The pipe 57 leads to collector 60 and the exhaust pipe 61 therefrom leads to blower 53. The unit 57, 60 and 61 operates by suction alone. Any uncollected material from pipe 61 passes through pipe 52 back to collector 55 and thence again to collector 60, except that if any of such material should remain uncollected at 55 it would go back through other parts of the system as already described.

From collector 60 the material may be discharged completely dried through a valve or feeding device 41^d into the hopper 63.

I claim:

1. The steps in the method of treating finely-divided material which consists in continuously introducing such material into an aeriform treating current which carries the material along, continuously separating out the material from said current, continuously introducing the separated-out material into another aeriform treating current which carries the material along, and collecting the material from said other current.

2. The method of treating finely-divided material as a continuous operation which includes introducing the material successively into a series of aeriform currents capable of changing the character of the material and which currents respectively carry the material along, the material being collected from one current and then introduced into the next in series as a continuous operation.

3. The method of treating finely-divided material by means of aeriform currents capable of changing the character of the material and in which the material is carried during the treatment, which includes subjecting the material to a succession of such currents one after the other and as a continuous operation.

4. The method of treating finely-divided moist material which includes the extraction of moisture from the material by aeriform currents which successively act upon the same material separated out of the current next before in the series.

5. The method of treating finely-divided moist material which includes the formation of heated aeriform currents and introducing the same material into each of such currents successively and as a continuous operation.

6. The method of treating finely-divided moist material which includes the formation of a plurality of heated air currents and introducing the material into such currents successively, one after the other, as a continuous operation, while maintaining the material free from association with air which has not been heated.

7. The method of treating finely-divided moist material which includes the formation of aeriform currents in a series and which merge one into another, and introducing the same material successively into such air currents ahead of the places respectively where they so merge.

8. The method of treating finely-divided moist material which includes the formation of a series of independent aeriform currents capable of extracting moisture from the material, introducing the material into the first current of the series so as to be carried along by the current, collecting material from said first current and introducing it into the second current of the series so as to be carried along by that current, collecting most of the material from the second current and introducing it into the third current so as

to be carried along by that current, and collecting material from the third current, all as a continuous operation, and while continuously reintroducing uncollected material from one current into one of the other currents.

9. The method of treating finely-divided moist material which includes the formation of a series of independent aeriform currents capable of extracting moisture from the material, introducing the material into the first current of the series so as to be carried along by that current, collecting material from said first current and introducing it into the second current of the series so as to be carried along by that current, collecting most of the material from the second current and introducing it into the third current so as to be carried along by that current, and collecting most of the material from the third current, all as a continuous operation and while continuously reintroducing uncollected material from some of the currents into preceding currents.

10. The method of treating finely-divided moist material which includes the formation of a series of independent aeriform currents which are substantially vertically directed to a materially large extent and which are capable of modifying the material, introducing the material into the first current of the series so as to be carried along by the current, collecting material from said first current and introducing it into the second current of the series so as to be carried along by that current, collecting most of the material from the second current and introducing it into the third current, and collecting most of the material from the third current, all as a continuous operation and while continuously reintroducing uncollected material into a current of the series having some of the material therein which has been modified by the treatment to a less extent than is such uncollected material.

11. In a treating system of the character described, the combination of a series of tubular members with means for forcing a separate aeriform current through each, means for introducing into the first tubular member of the series finely-divided material to be treated, separate means at the ends of said tubular members respectively, and collecting such material from the currents respectively, and means associated with one of said collecting means for introducing the material collected therein into the next in series of said tubular members.

12. In a treating system of the character described, the combination of a series of units each comprising a treating pipe and a collector, with means for continuously feeding collected material from a collector, into a treating pipe of the next unit, means for continuously introducing material into the first pipe of the series, and means for causing an aeriform treating current to flow in each unit from the place where the material is introduced in each unit to the collectors respectively.

13. In a treating system of the character described, the combination of a series of units each comprising a treating pipe and a collector, with means for continuously feeding collected material from a collector into a treating pipe of the next unit, means for continuously introducing material into the first pipe of the series, and means for causing an aeriform current to flow through the first unit at a relatively high velocity and through the following unit at a lesser velocity.

14. In a treating system of the character described, the combination of a series of tubular members substantially vertically disposed throughout a materially large extent of their respective lengths, means at the discharge ends of said tubular members respectively for collecting finely-divided material from an aeriform current carrying the same, means for introducing into the first of said tubular members in the series such finely-divided material, means associated with the first collecting device of the series for introducing collected material from that device into the second tubular member of the series, means for causing an aeriform current to flow in each of said tubular members toward the collecting means respectively, and means for heating a plurality of said currents.

15. In a treating system of the character described, the combination of a plurality of units through which the material may successively pass, each unit comprising a treating pipe and a collector, means for causing an aeriform current to flow in each unit toward the collector element thereof, and means for heating each of said aeriform currents.

16. In a treating system of the character described, the combination of a plurality of units through which the material may successively pass, each unit comprising a treating pipe and a collector, and means for causing an aeriform current of different temperatures respectively to flow in each unit toward the collector element thereof.

17. In a treating system of the character described, the combination of pipe means having an intake end and a discharge end, said pipe means including a plurality of collectors spaced apart intermediate the discharge end and the intake end of the pipe means, one of said collectors having conduit means associated with it for discharging an air current therefrom into said pipe means at a place anterior to said one of the collectors, means for introducing such finely-divided material into said pipe means

near the front end thereof, and means for causing a plurality of different aeriform currents to flow in different parts of said pipe means respectively.

18. In a treating system of the character described, the combination of a series of tubular members substantially vertically disposed throughout a materially large extent of their respective lengths, means at the discharge ends of said tubular members respectively for collecting finely-divided material from an aeriform current carrying the same, means for introducing into the first of said tubular members in the series finely-divided material, means associated with the first collecting device of the series for introducing such material collected thereby into the second tubular member of the series, means for causing an aeriform treating current to flow in each of said tubular members toward the collecting means respectively, and means for conducting one of said air currents away from one of the collecting means and redischarging it into the system whereby such uncollected material will be carried to the first collector of the series.

19. In a treating system of the character described the combination of a series of treating pipes and cyclone collectors in alternate arrangement, the pipes being substantially vertically disposed throughout a materially large part of their respective lengths, one of said collectors being at the rear end of the system, each intermediate collector having means associated therewith for feeding finely divided material into the treating pipe next following in the direction of travel of the material through the system, means for introducing such material into the first pipe of the series, means for causing an aeriform treating current to flow in each of said pipes, and with a greater velocity in the first thereof, to carry such material to the collectors respectively, and means for conveying exhaust current from one of said collectors and discharging it into the system at a place ahead of one of said collectors.

20. In a drying system of the character described, the combination of a series of treating pipes and collectors in alternate arrangement, the pipes being substantially vertically disposed throughout a materially large part of their respective lengths, the collectors respectively being adapted to collect finely-divided material from an air current, one of said collectors being at the rear end of the system, each intermediate collector having means associated therewith for introducing finely-divided material collected thereby into the treating pipe next following, means for introducing such material into the first pipe of the series, and separate blower and heater means for each unit for causing a heated aeriform current to flow in each of said pipes to carry such material to the collectors at the ends of the pipes respectively.

PHILIP A. SINGER.