

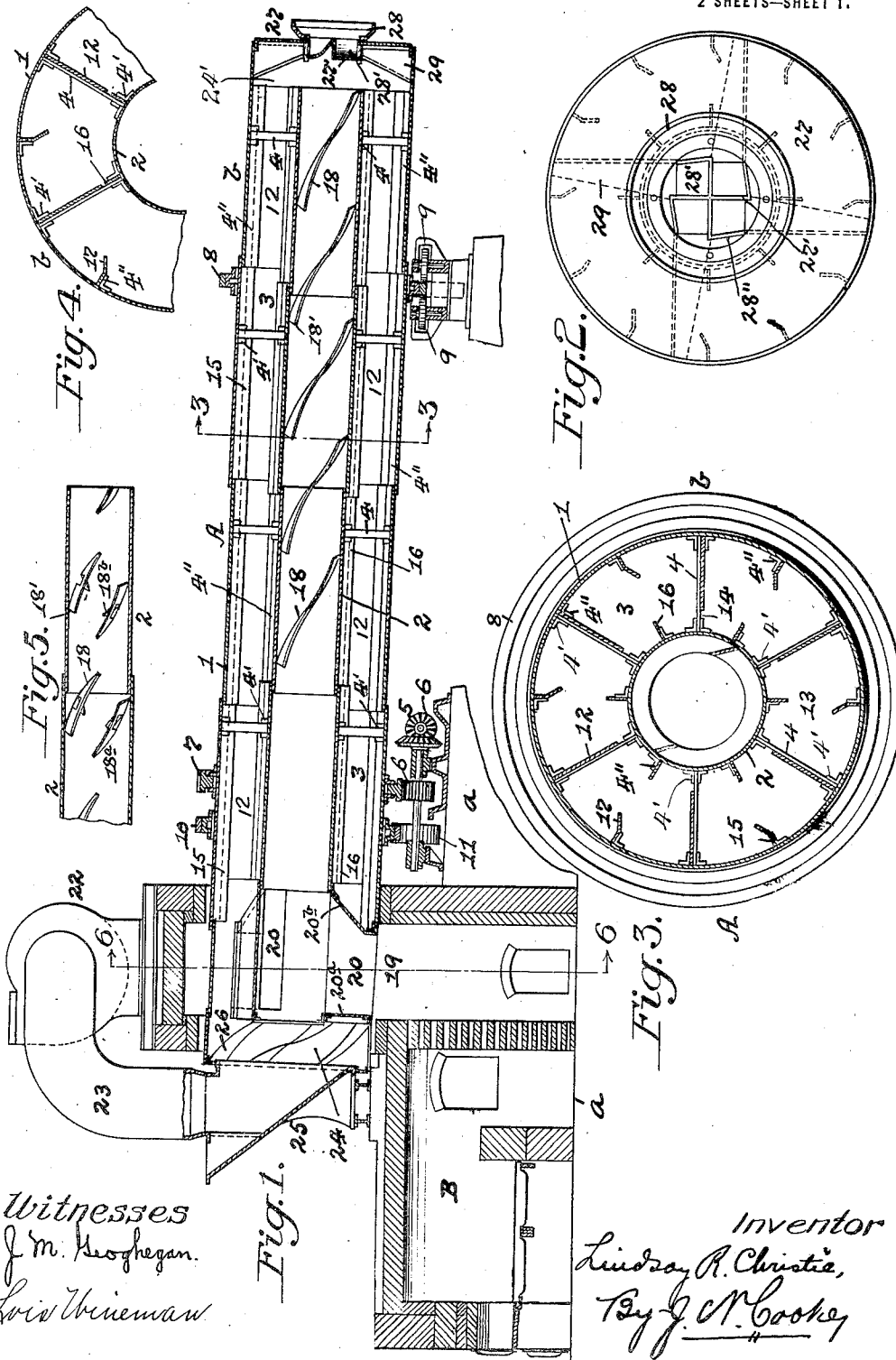
L. R. CHRISTIE
DRIER.

APPLICATION FILED JAN. 6, 1919.

1,332,380.

Patented Mar. 2, 1920.

2 SHEETS—SHEET 1.



Witnesses
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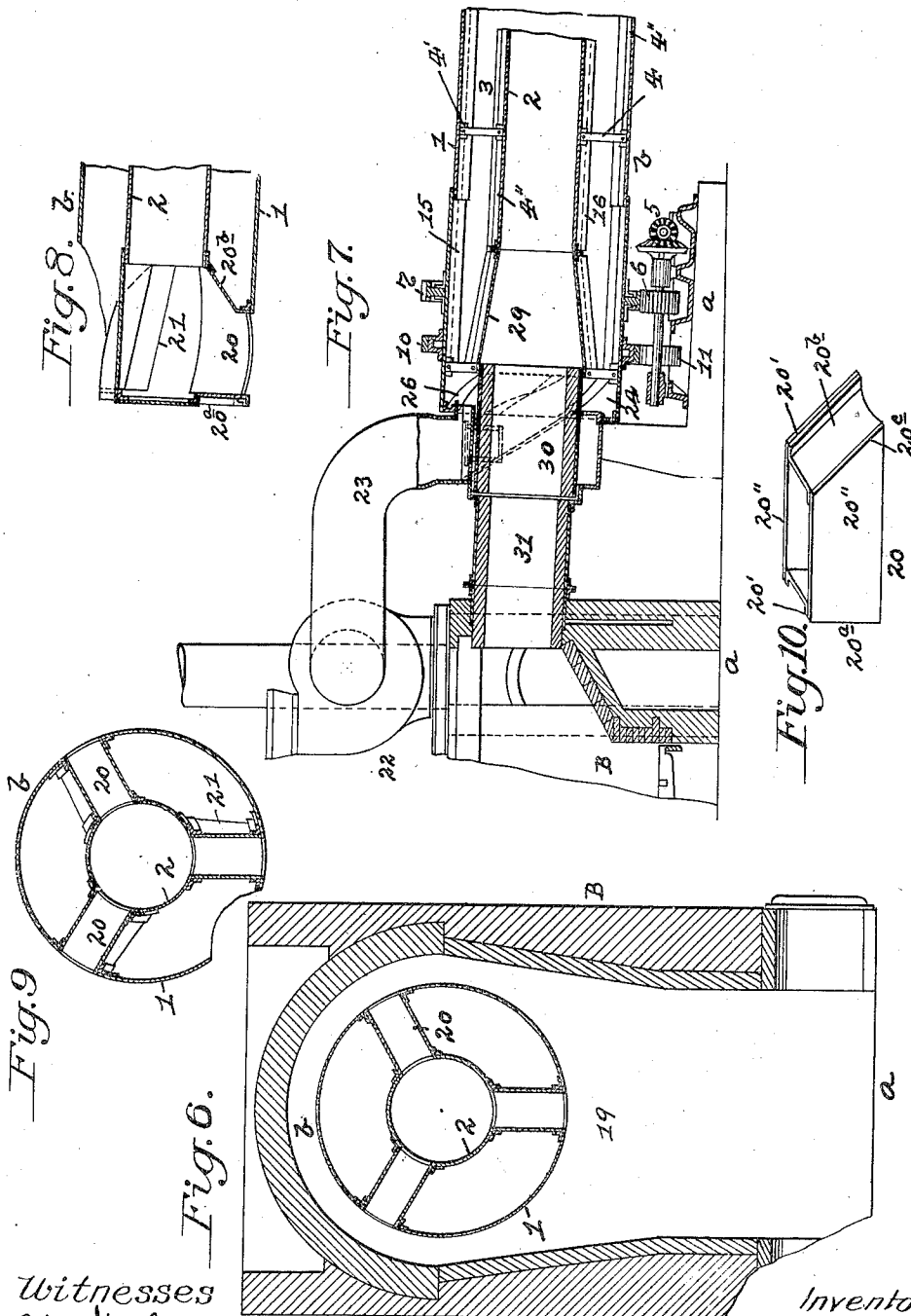
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UNITED STATES PATENT OFFICE.

LINDSAY R. CHRISTIE, OF PITTSBURGH, PENNSYLVANIA.

DRIER.

1,332,380.

Specification of Letters Patent.

Patented Mar. 2, 1920.

Application filed January 6, 1919. Serial No. 269,753.

To all whom it may concern:

Be it known that I, LINDSAY R. CHRISTIE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Driers; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to driers, and has special reference to what are known as direct heat driers for use in drying granular or clayey material.

The object of my invention is to produce a cheap, simple and efficient form of a drier, which can be conveniently and easily operated, will be strong, compact and not liable to get out of order, and will quickly and thoroughly dry the material fed to the same.

To these ends my invention consists, generally stated, in the novel construction, arrangement and combination of parts, as hereinafter more specifically set forth and described and particularly pointed out in the claims.

To enable others skilled in the art to which my invention appertains to construct and use my improved drier, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of my improved drier;

Fig. 2 is a rear end view of the same;

Fig. 3 is an enlarged cross-section of the drier on the line 3—3 Fig. 1;

Fig. 4 is a detail sectional view similar to that shown in Fig. 3, and showing another manner of arranging the flights in the drying chambers;

Fig. 5 is a view of the inner shell showing another form of the helical flights.

Fig. 6 is a cross sectional view of the apparatus on the line 6—6 Fig. 1;

Fig. 7 is a sectional view showing another manner of leading the gases into the inner shell.

Figs. 8 and 9 are detail views showing another form of the nozzles; and

Fig. 10 is a perspective view of one of the nozzles shown in Fig. 1.

Like symbols of reference herein indicate like parts in each of the figures of the drawing.

As illustrated in the drawings my im-

proved drier is shown at A and is adapted to be mounted on any suitable foundation or base, as at *a*, and preferably at an incline. This drier A comprises a cylindrical drum *b* having an outer shell 1 and an inner shell 2, which are separated from each other to form the space 3 between the same by means of the supporting arms 4 connected to such shells by the angles 4' and by the nozzles hereinafter described. These arms are loosely mounted at their connections between the shells 1 and 2 in any suitable manner to permit of unequal expansion in the shells 1 and 2. These two shells 1 and 2 are adapted to be rotated together by means of any suitable mechanism 5 supported on the base *a* at the front end of the drum *b* which is connected through suitable gearing 6 with a gear wheel 7 surrounding the outer shell 1 and operated by any suitable source of power. The rear end of the drum *b* is supported on a bearing ring 8 surrounding the outer shell 1, which travels within horizontally mounted supporting wheels 9 supported by the base *a*, and the front end of such drier is supported by a like bearing ring 10 which travels on vertically mounted supporting wheels 11 supported on said base.

Fitting over the supporting arms 4 and attached at their outer ends by the angles 4'' to the outer shell 1 are the deep flights 12, which are adapted to form chambers 13 in the space 3 between the shells 1 and 2. These flights 12 extend almost to the angles 4' on the inner shell 2 for supporting the arms 4, so that a gap or opening 14 is formed between the inner ends of said flights and the said shell.

Within the chambers 13 are the short flights 15 and 16, which are spaced from the flights 12 and are respectively secured to the interior of the shell 1 and the exterior of the shell 2 by the angles 4'', and the flights 15 may have their inner or free ends bent upwardly to form the shelf portions 17 thereon.

Within the inner shell 2 and somewhat away from the front or hot end of said shell are a number of helical flights 18, which extend to the rear end of said shell and are of spiral form for accelerating the movement of the gases hereinafter described in passing through said shell.

The gases generated in the furnace B are

taken therefrom and passed through the chamber 19 around the outer shell 1 at the feed end, which will enable such gases to give up some of their heat and thereby prevent any sticky material being dried from adhering to the shell. The gases are then passed from the chamber 19 through a series of flat sided or rectangular shaped nozzles 20 into the inner shell 2, such nozzles being connected between the shells 1 and 2 and will give an additional heating surface, as well as allowing an uncongested inlet for the wet material to enter the chambers 13, as hereinafter described.

Mounted on top of the furnace B is the exhaust fan 22, which has the exhaust flue 23 connected to the same and with the hopper 25 placed at the front end of the drum 6, which leads to the chamber 24 communicating with the chambers 13.

The material to be dried is passed through the hopper 25 and into the chambers 13 by means of helical flights 26 in the chamber 24, and such flights are secured to the outer shell 1.

At the rear end of the drum 6 is the discharge head 27, which is connected to the rear end of the outer shell 1 and is provided with a discharge opening 28 in the same. This opening has a discharge casting 27' in the same, which is provided with a series of chutes 28' for communicating with the open air at their outer ends and at their inner ends with the lower end of the buckets 29 in the head 27. The material after drying is discharged through the head 27, as the drum 6 is rotated, and the buckets 29 will carry such material from the bottom of the shell 1 up until it slides down by gravity through the casting 27' and chutes 28'. The chutes 28' may be provided with the diverging sides 28'', which will enable the material to free itself from the chutes and thus prevent choking of the same when one of the chutes is in position under its bucket 29 for discharging the material and when such bucket reaches substantially a vertical position, as the drum 6 is rotated.

The use and operation of my improved drier is as follows: With the furnace B in operation in the ordinary manner and with the use of any particular fuel in the same as described, the gases generated in the furnace will pass in the usual way therefrom through the nozzles 20 leading from the furnace into the inner shell 2, while the material to be dried will be placed into the chamber 24 through the hopper 25 and from said chamber the material will be carried up into the chambers 13 by means of the flights 26,—with the rotation of the shells 1 and 2 by the mechanism 5. The gases will circulate through the inner shell 2, and through the open rear end of the same, back

through the chambers 13 between such shell and the shell 1 by reason of the exhaust fan 22 being in operation and the exhaust flue 23 thereon being connected with the front open ends of said chambers through the chamber 24, so that such gases will thus be exhausted through said fan to the open air and during their circulation, as above described, will dry the material in the chambers 13. As the material enters the chambers 13 from the hopper 25 and flights 26, it will be caught by the flights 12 and 15 on the outer shell 1 and thus works its way through said chambers, and throughout the lengths of the same, so that it can be thus dried and dropped into the chamber 24, beyond the shell 2. After being thus dropped into the chamber 24' it is discharged through the discharge head 27 at the rear end of the drier, such movement of the material being due to the inclination of the shells 1 and 2 and the rotation of the same. During this movement of the material through the chambers 13 and as it is being dried in such chambers 13 by the circulation of the gases through the inner shell 2 and such chambers, the material in the said chambers will be lifted up by the flights 15 and their shelves 17, so that it can drop down onto the flights 12 and 16 and thence onto the inner shell 2, thus cascading the material through the returning hot gases in said chambers, as such shells revolve, and as such gases pass to the fan 22. The gap or opening 14 formed at the inner ends of the flights 12 on the outer shell 1 is arranged so that the material will fall through the gases, while the flights 16 on the inner shell 2 are so arranged with relation to the deeper flights 12 that very little, if any, of the material can fall on the outer shell without first having passed over the inner shell.

For certain materials it may be advisable, as shown in Fig. 4, for the flights 16 on the inner shell 2 to be placed directly opposite the deep flights 12 on the outer shell 1, which will thus form practically a continuous plate and thus do away with the possibility of cascading the material from the deep flights but making more positive the depositing of the material on the inner shell, while a certain amount of such cascading will still be maintained by the intermediate shallow flights 15 on the outer shell and which flights may be one or more in number between each deep flight 12.

If desired, the helical flights 18 can be placed at an angle to the radii of the inner shell 2 and also at an angle to the axis, so that the innermost edge 18' of the flights points toward the approaching gases, such as is shown in Figs. 1 and 3, and thus will cause the gases which pass over the top of the flights to be drawn down into the rarefied space behind the flights, thereby giving

an impinging effect and offsetting the rarefaction. The flights 18 may also be staggered as shown at 18^a, and cut and bent at an angle 18^b, as shown in Fig. 5, so as to form eddy currents to increase the motion of the gases over the surfaces.

Instead of taking the gases from the furnace B around outer shell 1 and into the inner shell 2 by means of the nozzles 20, the front end of the shell can be flared outwardly, as at 29, to form an enlarged portion thereon, as shown in Fig. 7, and thus prevent the gases from impinging against such front end, which will thereby retard their velocity and overcome the tendency of the plates composing such shell to burn out. Extending out from the front end of the enlarged portion 29 on the shell 2 is the collar or sleeve 30, which connects with the flue 31 leading from the furnace B for supplying the gases to the drum *b*.

It is obvious that if the nozzles 20 were not frequently cooled by the wet material falling over their surfaces, they would soon be destroyed by the high temperatures, and for this reason they are arranged as shown in rectangular or flattened form to retain the wet material on their several surfaces and to a maximum degree during the rotation of the cylinder *b*. To more clearly describe this point, as the material enters the chamber 24, some of the helical flights 26 therein are so placed as to deliver the wet material against the rear ends 20^a of the nozzles 20 where it is retained by the side plates 20'' of said nozzles until it is lifted to the top of the nozzles and slides down over the surfaces of the same, such plates extending beyond the ends of the nozzles to form the flanges 20'. The balance of the material enters the spaces between the nozzles 20 and will slide over the surfaces of the nozzles as the cylinder *b* rotates and such material will advance until it reaches the inclined or farther ends 20^b of the nozzles where such end of the rear side plate 20'' is flush with the end as at 20^c, and the opposite side plate being extended, the wet material will be caught against the end plate 20^b at the bottom and lifted up by the rotation of such cylinder until it slides over the surfaces of the nozzles. As shown in Figs. 8 and 9, these nozzles 20 can be set at an angle to the horizontal axis of the cylinder *b*, as shown at 21, in which case the material will be conveyed more rapidly into the chambers 13, and will insure the retaining of the material on its surfaces as above described.

Various other modifications and changes in the design and construction of my improved drier may be resorted to, without departing from the spirit of the invention or sacrificing any of its advantages.

It will be obvious that the construction of my improved drier will give the highest

temperature and greatest heating surface where the material is the wettest and will not be liable to injury from the heat, while at the same time the arrangement gives the maximum heating surface and capacity for floor space.

It will also be seen that the evaporated moisture from the drying material does not pass over the dried material, which thus avoids possibility of recondensation in same and permits a minimum temperature and quantity of heat to be carried away through the fan.

What I claim as my invention and desire to secure by Letters Patent is:

1. A drier comprising a rotatable drum having an inner shell and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for heated gases and communicating at its rear end with said spaced portion, means for feeding the material to be dried into said spaced portion, a discharge means for the material at the rear end of said outer shell, and means within said spaced portion for forming a series of chambers between said shells and for catching the material to deposit the same on the exterior of the inner shell.

2. A drier comprising a rotatable drum having an inner shell and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for heated gases and communicating at its rear end with said spaced portion, means for feeding the material to be dried into said spaced portion, and flights within said spaced portion and secured to said outer shell, said flights extending adjacent to said inner shell for forming a series of chambers between said shells and being adapted to catch the material for depositing the same on the exterior of the inner shell.

3. A drier comprising a rotatable drum having an inner shell and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for heated gases and communicating at its rear end with said spaced portion, means for feeding the material to be dried into said spaced portion, and flights in said spaced portion and secured to said outer shell for forming a series of chambers, said flights extending in close proximity to said inner shell and having an opening formed between the inner end of the same and said shell and being adapted to catch the material for depositing the same on the exterior of said inner shell.

4. A drier comprising a rotatable drum having an inner shell and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for heated gases and communicating at its rear end with said spaced portion, means for

feeding the material to be dried into said spaced portion, flights within said spaced portion and secured to said outer shell, said flights extending adjacent to said inner shell
 5 for forming a series of chambers between said shells and being adapted to catch the material for depositing the same on the exterior of said shell, and shelves within said chambers and secured to the outer shell for
 10 lifting the material to be dropped on said flights.

5. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same,
 15 said inner shell forming a flue for the heated gases and communicating at its end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing
 20 the material on the exterior surface of the inner shell, and means within said inner shell for accelerating the movement of the gases within said shell.

6. A drier comprising a rotatable drum
 25 having an inner and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its end with said spaced portion, means for feeding the
 30 material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of the inner shell, and helical flights within said inner shell for accelerating the movement
 35 of the gases within said shell.

7. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for the
 40 heated gases and communicating at its end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface
 45 of the inner shell, and helical flights within said shell having their edges at an angle to the radius of the flue and toward the approaching gases for accelerating the movement of the gases within said shell.

8. A drier comprising a rotatable drum having an inner and outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated
 50 gases and communicating at its rear end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface
 55 of said inner shell, and means at the front end of said drum for circulating the gases from their source of supply around the outer shell before entering the inner shell.

9. A drier comprising a rotatable drum having an inner and outer shell provided
 65 with a spaced portion between the same,

said inner shell forming a flue for the heated gases and communicating at its rear end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing
 70 the material on the exterior surface of said inner shell, a chamber around the front end of said outer shell, and nozzles between said outer and inner shells and communicating with said chamber, said chamber and
 75 nozzles being adapted to circulate said gases from their source of said supply around the outer shell before passing into said inner shell.

10. A drier comprising a rotatable drum
 80 having an inner and outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its rear end with said spaced portion, means for feed-
 85 ing the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of said inner shell, a chamber around the front end of said outer shell, and noz-
 90 zles between said outer and inner shells and communicating with said chamber, said nozzles being formed at an angle, said chamber and nozzles being adapted to circulate said gases from their source of supply to said
 95 inner shell.

11. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same, said
 100 inner shell forming a flue for the heated gases, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior of said inner shell, a discharge head on the rear end of said drum
 105 having rectangular shaped discharge chutes within the same, and buckets on the interior of said head for lifting the material from the bottom of the outer shell and emptying the same into said chutes.
 110

12. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated
 115 gases, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior of said inner shell, a discharge head on the rear end of said drum having chutes within the same, and buckets
 120 on the interior of said head for lifting the material from the bottom of the outer shell and emptying the same into said chutes, said chutes having diverging sides to permit the material to free itself from said chutes.
 125

13. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated
 130 gases, means for feeding the material into

said spaced portion, means within said spaced portion for depositing the material on the exterior of said inner shell, a chamber within the outer shell and beyond the inner shell for cooling the dried material, a discharge head on the rear end of said outer shell and beyond said chamber, rectangular shaped discharge chutes in said head, and buckets on the interior of said drum for lifting the material from the bottom of said chamber and emptying the same into said chutes.

14. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of the inner shell, and helical flights within said shell having their edges at an angle to the radius of the flue and toward the approaching gases for accelerating the velocity of the gases within said shell, said helical flights being staggered within said shell.

15. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of the inner shell, and helical flights within said shell having their edges at an angle to the radius of the flue and toward the approaching gases for accelerating the velocity of the gases within said shell, said helical flights having portions within the same cut and bent out at an angle to form wings.

16. A drier comprising a rotatable drum having an inner and outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its rear end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of said inner shell, a chamber around the front end of said outer shell, and rectangular-shaped nozzles between said outer and inner shells and communicating with said chamber, said chamber and nozzles being adapted to circulate said gases from their source of supply around said outer shell before passing into said inner shell.

17. A drier comprising a rotatable drum having an inner shell and outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its rear

end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of said inner shell, a chamber around the front end of said outer shell, and rectangular-shaped nozzles between said outer and inner shells and set at an angle to the horizontal axis for communicating with said chamber, said chamber and nozzles being adapted to circulate said gases from their source of supply around said outer shell before passing into said inner shell.

18. A drier comprising a rotatable drum having an inner and outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its rear end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of said inner shell, a chamber around the front end of said outer shell, and rectangular-shaped nozzles between said outer and inner shells and communicating with said chamber, said chamber and nozzles being adapted to circulate said gases from their source of supply around said outer shell before passing into said inner shell, and said nozzles having flange portions on each side of said ends and extending beyond the same.

19. A drier comprising a rotatable drum having an inner and outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at its rear end with said spaced portion, means within said spaced portion for depositing the material on the exterior surface of said inner shell, a chamber around the front end of said outer shell, and rectangular-shaped nozzles between said outer and inner shells and communicating with said chamber, said chamber and nozzles being adapted to circulate said gases from their source of supply around the outer shell before passing into said inner shell, and said nozzles having flange portions on each side of said ends and extending beyond the same and having one of said ends provided with a single flange.

20. A drier comprising a rotatable drum having an inner and an outer shell provided with a spaced portion between the same, said inner shell forming a flue for the heated gases and communicating at the rear end with said spaced portion, means for feeding the material into said spaced portion, means within said spaced portion for depositing the material on the exterior surface of said inner shell, a chamber around the front end of said outer shell, and flat sided nozzles between the said outer and inner shells and communicating with said chamber, said chamber and nozzles being adapted to circu-

late said gases from their source of supply around the outer shell before passing into said inner shell.

21. A drier comprising a rotatable drum
5 having an inner shell and an outer shell and having a space between the same, said inner shell forming a flue for heated gases and communicating at its discharge end with
10 said space, means for feeding the material to be dried into said space, and means within said space for forming a series of chambers between said shells and in communication
15 with one another near the inner shell for catching the material to deposit the same on the exterior of the inner shell.

22. A drier comprising a rotatable drum having an inner shell and an outer shell and

having a space between the same, said inner shell forming a flue for the heated gases and communicating at its discharge end with
20 said space, said outer shell having a discharge opening at its corresponding end, and means within said spaced portion for forming a series of chambers between said
25 shells and in communication with one another near the inner shell for catching the material to deposit the same on the exterior of said inner shell.

In testimony whereof, I, the said LINDSAY R. CHRISTIE, have hereunto set my hand.

LINDSAY R. CHRISTIE.

Witnesses:

J. M. GEOGHEGAN,

J. N. COOKE.