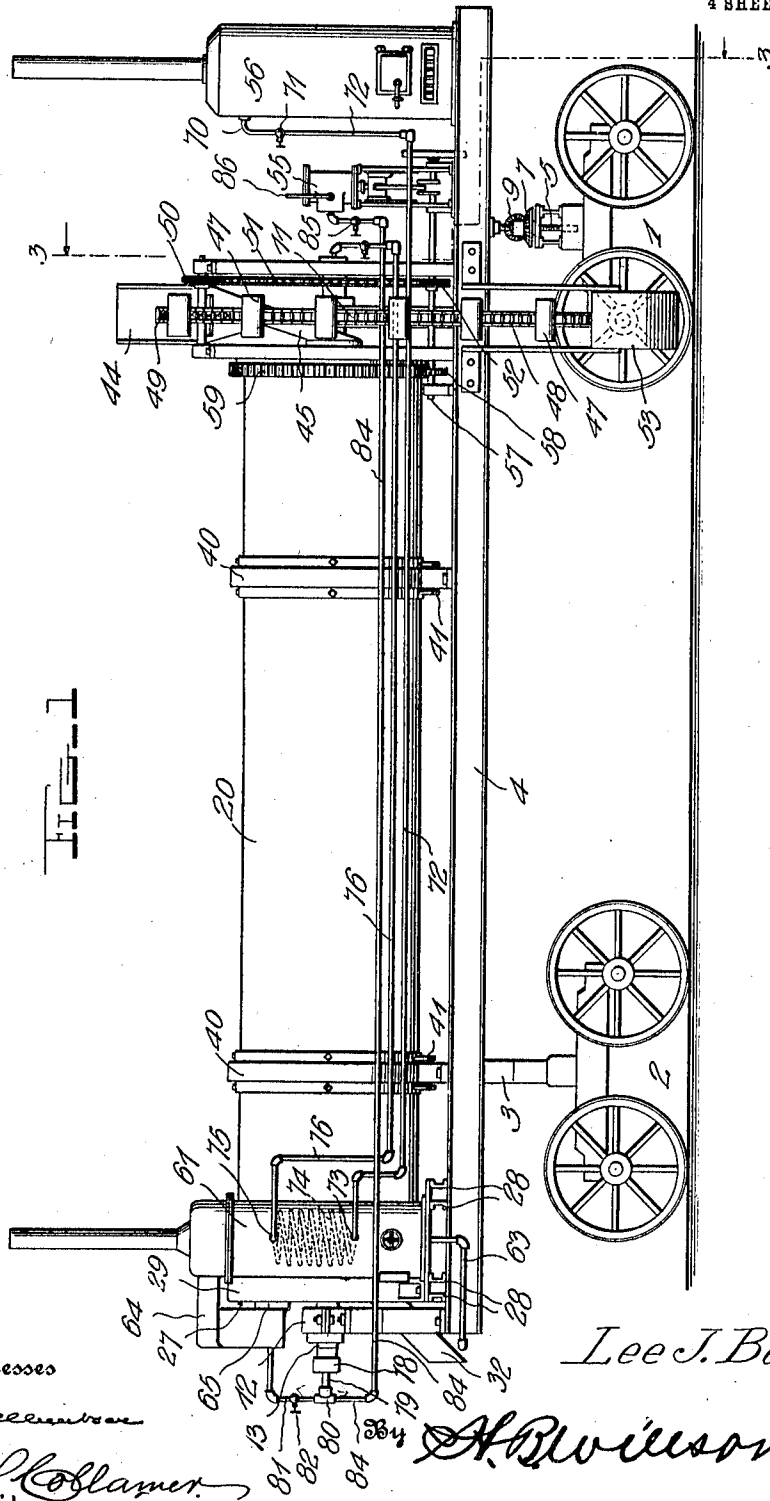


L. J. BLACK.
 DRYING MACHINE.
 APPLICATION FILED JULY 10, 1912.

1,055,125.

Patented Mar. 4, 1913.

4 SHEETS-SHEET 1.



Witnesses

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4 SHEETS—SHEET 2.

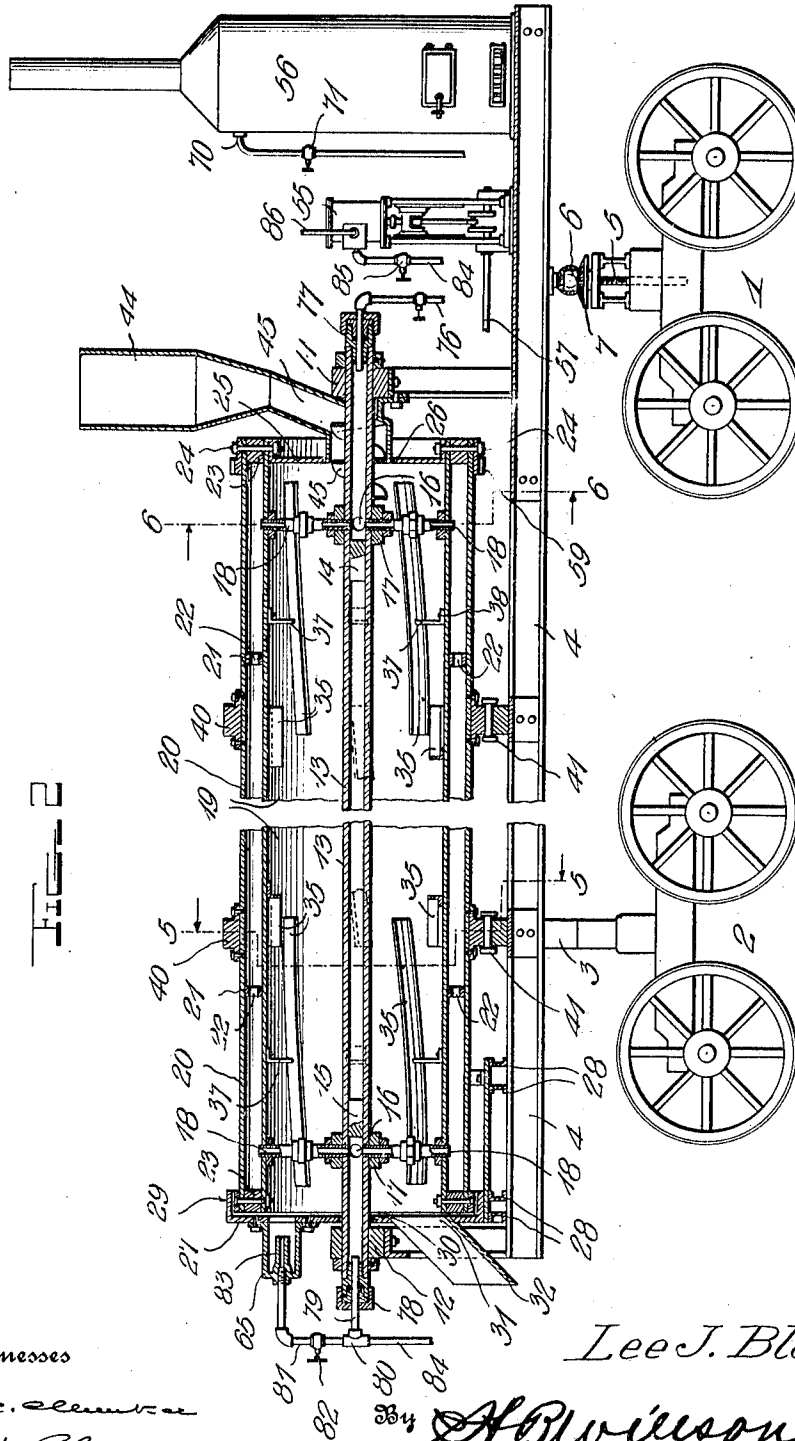


FIG. 2

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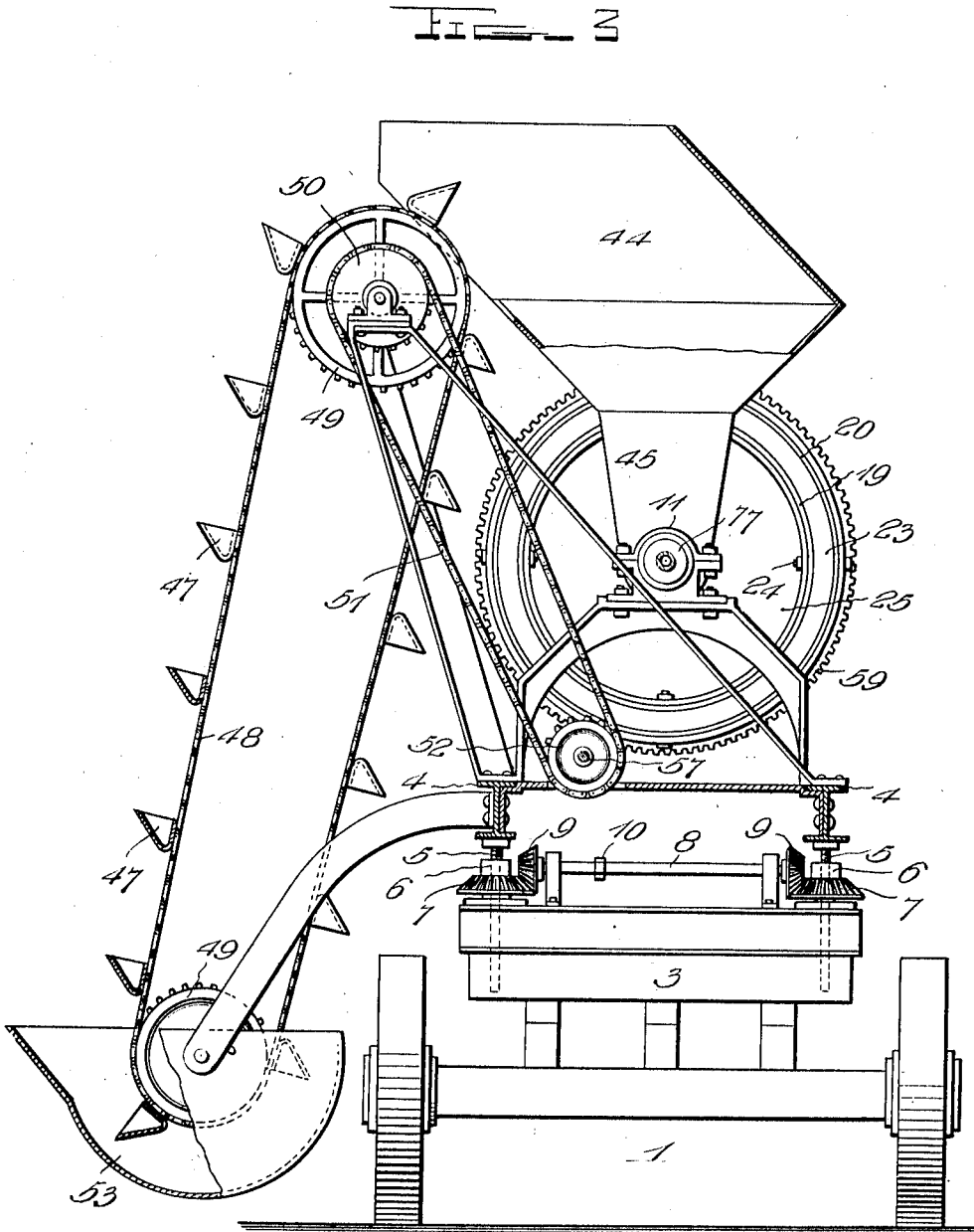
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4 SHEETS-SHEET 3.



Inventor

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Witnesses

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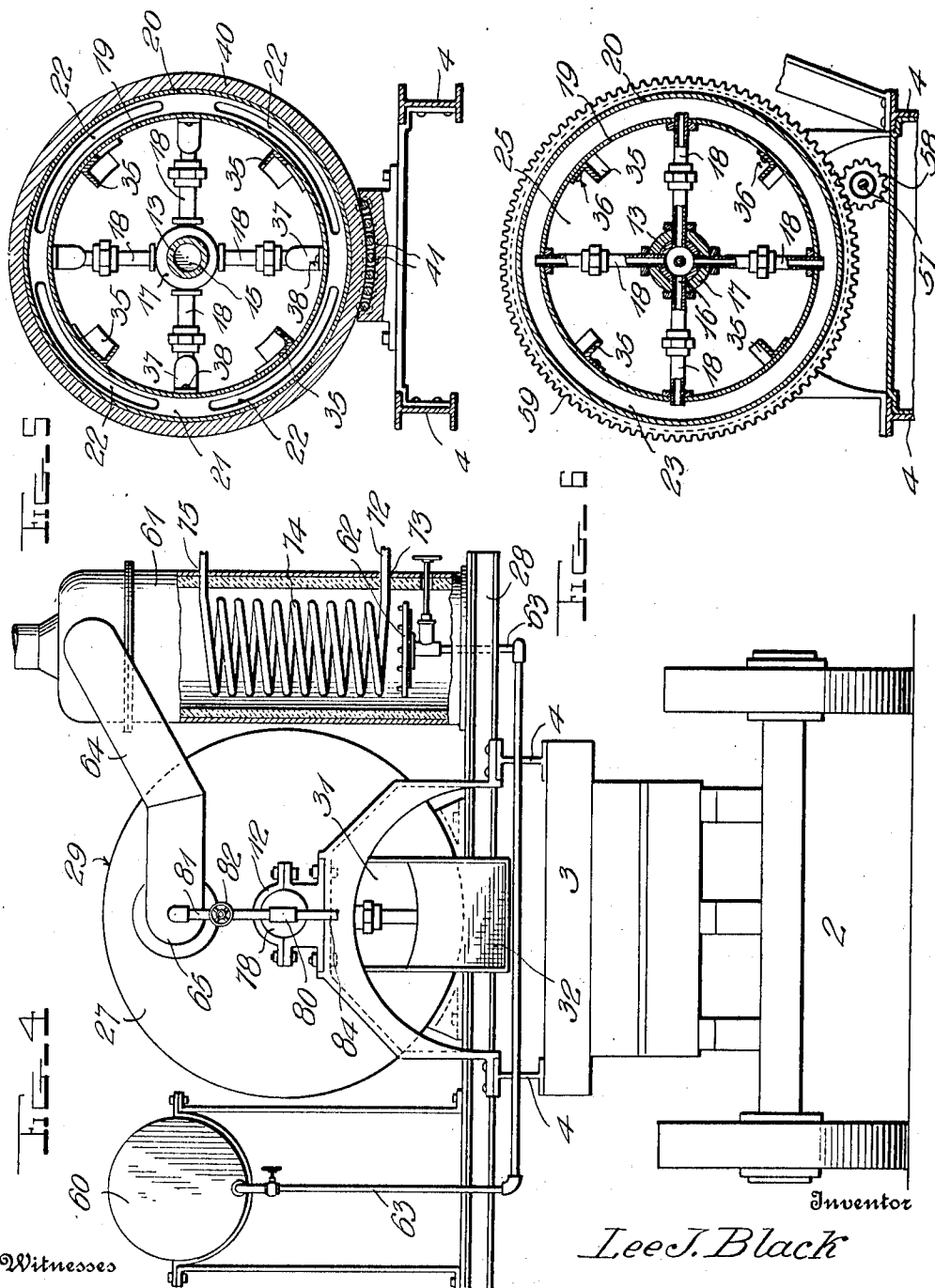
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4 SHEETS—SHEET 4.



Witnesses

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384

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UNITED STATES PATENT OFFICE.

LEE J. BLACK, OF BEAUMONT, TEXAS.

DRYING-MACHINE.

1,055,125.

Specification of Letters Patent.

Patented Mar. 4, 1913.

Application filed July 10, 1912. Serial No. 708,542.

To all whom it may concern:

Be it known that I, LEE J. BLACK, a citizen of the United States, residing at Beaumont, in the county of Jefferson and State of Texas, have invented certain new and useful Improvements in Drying-Machines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to driers, and more especially to those having a horizontal rotating cylinder; and the object of the same is to produce a machine for drying and heating crushed stone, sand, clay, ore, or any product which requires extreme caution on account of its liability of being burned in the process of drying and heating, such as bituminous rock or a mixture of rock, sand, and asphalt.

The object of the invention is to improve the construction of a machine of this character, to which end it consists in the details hereinafter more fully set forth and claimed and as shown in the drawings—

Figure 1 is a side elevation of this machine complete; and Fig. 2 a central longitudinal section through the same, with its trucks in side elevation; Fig. 3 is a cross section on the line 3—3 of Fig. 1. Fig. 4 is an enlarged rear end elevation with the heater in section; Figs. 5 and 6 are cross sections on the lines 5—5 and 6—6 of Fig. 2.

Mounted on any suitable support such as the trucks 1 and 2 is a base comprising parallel sills 4 carrying the necessary cross beams or supports for the instrumentalities hereinafter described. By preference I support said sills on a bolster 3 over the rear truck and an adjusting mechanism of any suitable type over the front truck, herein shown in Fig. 3 as consisting of oppositely threaded screws 5 depending from the sills 4 through nuts 6 constituting the hubs of beveled gears 7, which are connected by a cross shaft 8 having beveled gears 9 at its extremities, and this shaft may be turned in either direction by any suitable means such as the application of a wrench to the squared portion 10. This adjusting mechanism may be replaced by any other, or might be omitted entirely, but when used as herein specifically illustrated, it serves to adjust the base and the instrumentalities carried thereby so that the main cylinder

shall incline a little to the rear of the machine for a purpose to be set forth below. However, if this improved drier is mounted on a fixed support, the bearings for said cylinder will be so disposed that it will incline as mentioned, and then of course the trucks and the adjusting mechanism will be dispensed with.

Mounted in bearings 11 and 12 carried by the base is a tubular shaft 13 which is plugged at 14 and 15 near its front and rear ends respectively and perforated at 16 just outside said plugs and through hubs 17 surrounding the shaft where it is perforated lead tubular spokes 18 (four in each group are shown) whose outer ends pass through the inner shell 19 of the cylinder. The latter is composed of said inner shell and an outer shell 20 spaced therefrom by rings 21 located at intervals, and each ring is perforated as at 22 to allow the free passage of heat through the annular jacket thus formed between the two shells. The extremities of the latter are connected by solid rings 23 and bolts 24, and the bolts at the front engage and hold in place a head 25 which is pierced with a central opening 26 around and larger than the shaft. The rear head 27 is a cast-iron hood fixedly mounted on the base as by being supported on cross beams 28 resting on the sills 4, and this hood has an annular flange 29 surrounding the rear end of the outer shell and a central opening 30 through which the shaft 13 passes. It is also provided below this opening with another opening 31, in which is secured a delivery spout 32 out of which the heated material falls and from which it may be delivered into a suitable receptacle or possibly onto the pavement or to the place of use in case the machine is mounted on trucks as illustrated.

The agitating mechanism comprises a number of series of spiral wings or flukes 35 bolted as at 36 to the inner shell, and in the present case I have shown two series located respectively near the opposite ends of the cylinder, and four wings in each series. Their obvious purpose is to agitate the material fed into the forward end of the cylinder and which drops first upon the bottom thereof, carry it around within the inner shell to a point where it drops off each wing and again falls to the bottom thereof, and meanwhile feed it toward the rear or delivery end of the cylinder by reason of the

inclination of the latter and the spiral disposition of the wings. The agitating mechanism furthermore includes a series of cross paddles 37 bolted as at 38 to the inner shell, and by preference disposed adjacent the inner end of the wings of each series above described; and their function is to break up the substance being heated or dried and prevent it from balling while in a moist state, as it is well known that any substance of a sticky nature that is rolled with a circular motion will form into balls or clods which prevent the heat from penetrating to the center of the same. The agitating mechanism might be said to further include the radial spokes 18 which connect the shaft 13 with the inner shell and which of necessity revolve with said shaft and cylinder. With these exceptions the interior of the latter is free for the passage of the material from the inlet to the outlet end thereof. The material of which the cylinder is composed is preferably sheet iron, with metal tubing for the shaft and spokes, but the nature of the material and the size and exact proportions of parts are immaterial, and changes in the details of this machine throughout all its parts may be made so long as the spirit of the invention is retained. If the length of the cylinder is sufficient, it may be wise to surround it by heavy bands or ways 40 resting on grooved rollers 41 suitably supported on the base, and this detail will support the cylinder between its extremities or between the hubs 17 where it is supported on the shaft and will additionally brace the outer shell by reason of the surrounding ways.

The feed mechanism best seen in Fig. 3 comprises a hopper 44 whose spout 45 is directed through the inlet opening 26 in the front head 25 as seen in Fig. 2, and within this spout the rotating shaft 13 preferably carries a worm 46 so that the material within the spout is forced through the opening and into the front end of the cylinder. The feed mechanism might be said also to include an elevator best seen in Fig. 3, herein shown as consisting of buckets 47 mounted on an endless chain 48 which moves over sprockets 49 at its upper and lower ends, the uppermost sprocket having a sprocket gear 50 on its shaft connected by a belt 51 with another sprocket gear 52 which is driven in a manner yet to be described. The lowermost sprocket 49 and the lower end of the chain are properly supported to cause the buckets to dip into a trough 53 into which the material to be treated may be dumped or shoveled, and the uppermost sprocket is properly supported to cause the buckets to deliver said material from the trough into the hopper 44, whence it is carried into the inlet end of the cylinder in a manner described above. However, I do not wish to be limited to the use of this form of

elevating mechanism, or, in fact, to the use of any elevating mechanism, as it might be possible to deliver the material into the hopper 44 by other means—especially if this machine were mounted on a base which stood on the ground and in which case the top of the hopper would be at a height where the material might be shoveled into the same without the use of any elevator.

The driving mechanism may be any that is adapted to this machine, and I do not wish to be limited to what is shown and described herein simply for purposes of illustration.

At 55 is designated a steam engine driven by steam generated in a boiler 56, and the engine causes the rotation of a shaft 57 on which the sprocket gear 52 may be mounted so that the rotation of this shaft drives the elevator just described. Said shaft also carries a power gear 58 meshing with a toothed ring 59 surrounding the cylinder near its front end, and hence the rotation of the power shaft causes the rotation of the cylinder. It is obvious that the connection between the power shaft and the elevator and cylinder might be through other means, possibly through clutches so that these instrumentalities could be rotated independently of each other. However, as these details form no part of the present invention, they are not illustrated herewith. I might also add that, if desired, suitable power mechanism could be employed to raise or lower the front end of the cylinder in a manner set forth above; but as the adjustment thereof will be but little and will occur but seldom, I prefer that it shall be done by hand through the attachment of some ratchet mechanism to the squared portion 10 shown in Fig. 3.

The drying or heating mechanism or system, which might be said to form the gist of the present invention, will now be described: Mounted on one end of the cross beams 28 at the rear of the sill or base is a fuel reservoir, herein shown as a tank 60 containing oil. Mounted on the other ends of said beams is an upright heater 61, herein shown as provided with an oil burner 62 to which the fuel is led from said tank through a pipe 63 as best seen in Fig. 4, and the heater also being provided with a hot air outlet flue 64 leading through the rear head of the cylinder as shown at 65 in Fig. 2. Thus when oil is admitted from the tank 60 through the pipe 63 to the burner 62, the air admitted through the bottom of the heater is heated and passed out through the flue 64 into the cylinder at the point 65. Herein it is forced through the mass of tumbling material, and it finds its exit through the inlet opening 26, along the spout 45 and upward out the hopper 44. The heating system may be said also to comprise the arrangement and circulation of the steam in so far as it is employed to

create a draft of the hot air and to circulate within the steam jacket above described. In the arrangement illustrated in the drawings herewith, the course of the steam through proper pipes is from the boiler 56 at the point 70, through a valve 71 and along a pipe 72 into the heater 61 at the point 73, thence through a coil 74 located within the heater above the burner 62, thence outward through the shell of the heater at the point 75 and back through a pipe 76 to the front end of the shaft 13 through a suitable stuffing box 77. By this arrangement the temperature of the steam is brought up to a point of approximately nine hundred degrees F. where it enters the shaft. In the latter it passes out the openings 16, through the tubular spokes 18, and into the jacket between the two shells forming the body of the cylinder; and within the jacket it goes to the rear through the perforations 22 in the rings 21 and heats the entire cylinder; at the rear end of said cylinder it passes inward through the rearmost series of radial spokes beyond the rear plug 15, flows along the rear end of the main shaft through the rear bearing 12, and out a stuffing box 78 into a steam pipe 79. The latter has a T coupling 80 at this point, whose upper arm connects with a pipe 81 passing through a valve 82 and led to a steam jet 83 which is directed along the center of the inlet flue 65; whereas the lower arm of the T-coupling 80 connects with a pipe 84 by means of which the steam is again led back to the front end of the machine, and through a valve 85 into the steam chest of the engine 55, and after being used therein it is exhausted into the air at the point 86. It will be observed that this system of piping the steam causes the same to be super-heated within the heater which for convenience I have located at the rear part of the machine, then the steam is used to heat the steam jacket surrounding the cylinder, then the steam branches within the T-coupling 80 and part of it is used as a jet to create suction on the air which has been heated within the cylinder and to force said air throughout the length of the inner shell to dry and heat the material therein, and finally the remainder of the steam passing through the T-coupling 80 is led back to the engine and utilized to cause the rotation of the cylinder and to do other work if desired. With the understanding, however, that I do not wish to be confined to the precise details of construction, it will be clear that the power shaft might be rotated by some other form of engine, as for instance one driven by gasoline. The gist of the invention lies in the fact that I utilize the flow of steam through the jacket to heat the cylinder, and then jet it into the air inlet pipe both to create a draft within the air and a flow of the

latter through the cylinder, and to moisten the air because it is well known that steam will smother a flame without destroying the heat, and it might be possible that some of the particles in the substance being heated or roasted would become so hot as to ignite. My system, therefore, essentially uses the steam for three purposes (to heat the cylinder, jet the air, and smother fire), and incidentally may be used for a fourth purpose which is to drive the engine which drives the machinery. My system also uses the heater for two purposes, viz: heating the air which is to be jetted into the cylinder, and super-heating the steam. My system therefore uses both the steam and the air in conjunction with each other for a variety of purposes, all tending to the same end which is as stated at the beginning of this specification.

What is claimed as new is:—

1. In a drying machine, the combination with a substantially horizontal rotary cylinder comprising concentric shells with a space between them and mounted on a tubular shaft, and provided with an inlet at one end and an outlet at the other; of series of tubular spokes connecting said shaft and space near both ends of the cylinder, a plug within the shaft between the series, means for feeding a hot fluid agent into one end of the shaft, along said space, and out the other end of the shaft, and means for simultaneously feeding hot air into the outlet end of the cylinder, throughout the length of its inner shell, and out the inlet end thereof.

2. In a drying machine, the combination with a substantially horizontal rotary cylinder comprising concentric shells with a space between them and mounted on a tubular shaft, and provided with an inlet at one end and an outlet at the other; of series of tubular spokes connecting said shaft and space near both ends of the cylinder, plugs within the shaft between the series, means for feeding super-heated steam into one end of the shaft, throughout the length of the space, and out the other end of the shaft, means for feeding hot air into the rear end of the inner shell, throughout its length, and out its front end, and connections between the outlet end of the shaft and the inlet end of the air-feed for carrying a portion of the steam from the former to the latter and jetting it into the inner shell along with the air.

3. In a drier, the combination with a substantially horizontal rotary cylinder having a jacket throughout its length, a front head fixed therein and provided with a central opening, a stationary rear head provided with an outlet and another opening, and feed mechanism for delivering the material to be treated through the opening in the

- front head; of an air heater, a flue connecting it with said opening in the rear head of the cylinder, means for feeding steam throughout the length of said jacket, and connections between the jacket and the opening in the rear head for conveying the steam from the former to the latter and jetting it into the cylinder along with the hot air.
4. In a drier, the combination with a substantially horizontal rotary cylinder having a jacket throughout its length, a front head fixed therein and provided with an inlet opening, a stationary rear head provided with an outlet opening, and feed mechanism for delivering the material to be treated through the inlet opening in the front head; of an air heater, a flue connecting it with the rear opening in said cylinder, a coil within the heater, a steam generator connected with one end of the coil, connections between the other end thereof and one end of said jacket, and connections between the other end of said jacket and the rear opening in the cylinder whereby the superheated steam is conveyed from the former into the latter and jetted into the cylinder along with the hot air.
5. In a drier, the combination with a substantially horizontal rotary cylinder comprising shells with a space between them, a tubular shaft, two series of tubular spokes connecting the shaft with said space near the extremities of the cylinder, and plugs in the shaft between said series; of bearings for the ends of the shaft, stuffing boxes in said ends, a heater, a flue leading therefrom into the rear end of the inner shell, a coil within the heater, a boiler, an engine, a pipe leading from the boiler to said coil, a pipe leading from the coil through said stuffing box at the front end of the shaft, a pipe leading through the stuffing box at the other end thereof and branched, a pipe leading from one branch thereof to said engine, a pipe leading from the other branch thereof, and a jet on the extremity of this pipe for conveying steam along with the hot air into the interior of the inner shell.
6. In a drier, the combination with a substantially horizontal rotary cylinder comprising shells with a space between them, a tubular shaft, two series of tubular spokes connecting the shaft with said space near the extremities of the cylinder, and a plug in the shaft between said series; of bearings for the ends of the shaft, stuffing boxes in said ends, a heater, a flue leading therefrom into the rear end of the inner shell, a coil within the heater, a boiler, an engine, a pipe leading from the boiler to said coil, a pipe leading from the other end of the coil through said stuffing box at the front end of the shaft, a pipe leading through the stuffing box at the other end thereof and branched, a pipe leading from one branch thereof to said engine, a pipe leading from the other branch thereof, a jet on the extremity of this pipe for conveying steam along with the hot air into the interior of the inner shell, connections between the engine and the cylinder for rotating the latter, and feed mechanism comprising a hopper whose spout delivers into the front end of the cylinder, a trough, and an elevator conveying the material from the trough to the hopper and driven by said engine.
7. In a drier, a cylinder comprising concentric spaced shells, rings between them having perforations through their bodies, solid rings bolted between the extremities of said shells, a front head having a central opening and a radial flange engaged by the bolts of the front ring, a non-rotary rear head having a flange inclosing the rear end of the outer shell, and a shaft extending loosely through both heads and having series of spokes connected with the inner shell near the extremities of the cylinder; combined with means for directing a blast of hot fluid agent through the space between said shells, and means for directing a blast of hot fluid agent throughout the length of the inner shell.
8. In a drier, a cylinder comprising concentric spaced shells, rings between them having perforations through their bodies, solid rings bolted between the extremities of said shells, a front head having a central opening and a radial flange engaged by the bolts of the front ring, a non-rotary rear head having a flange inclosing the rear end of the outer shell, a tubular shaft extending loosely through both heads and mounted in bearings, the shaft having perforations near said heads, plugs within the shaft between said perforations, hubs fixed around the shaft outside said perforations, and a series of tubular spokes connecting each hub with the inner shell and establishing communication between one set of perforations in the shaft and the space between the shells; combined with means for feeding a hot fluid agent into one end of the shaft, throughout the length of the jacket, and out the other end of the shaft, and means for feeding a blast of hot fluid agent throughout the length of the inner shell outside of said shaft.
9. In a drier of the class described, the combination with a substantially horizontal cylinder having concentric shells with an annular space between them, a front head fixed within the inner shell and having a central opening, a shaft journaled in bearings, hubs on the shaft, and series of spokes radiating from said hubs to the inner shell; of a feed hopper having a spout extended through said opening in said head, a worm on the shaft within said spout, a non-rotary

rear head having a flange loosely surrounding the rear end of the outer shell and pierced with an opening for said shaft and an outlet opening beneath it, means for directing a blast of hot fluid agent throughout the length of said space, and means for directing a blast of hot fluid agent throughout the length of the interior shell.

10 In an agitating mechanism for a drier of the class described, the combination with a substantially horizontal rotary cylinder having an inlet at its front end and an outlet at its rear end, and means for feeding the material to be treated into the inlet of
15 said cylinder; of a shaft extending throughout the axis of said cylinder, series of radial spokes connecting said shaft and cylinder, means for feeding a blast of hot fluid agent throughout the length of the latter, two series of spiral wings secured within the cylinder respectively near the ends thereof and
20 disposed so as to feed the material from the inlet toward the outlet, and two series of

cross paddles fixed within the cylinder between said series of wings, for the purpose set forth.

11. In an agitating mechanism, the combination with a substantially horizontal rotary cylinder, and means for feeding the material to be treated into its front end; of
30 means for rotating said cylinder, means for directing a blast of hot fluid agent throughout the length of its interior, two series of spiral wings secured within the cylinder respectively near the ends thereof, and cross
35 paddles fixed within the cylinder between said series of wings, for the purpose set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses. 40

LEE J. BLACK.

Witnesses:

CARR P. COLLINS,
JOHN L. BAKER.