C. W. HOWARD.

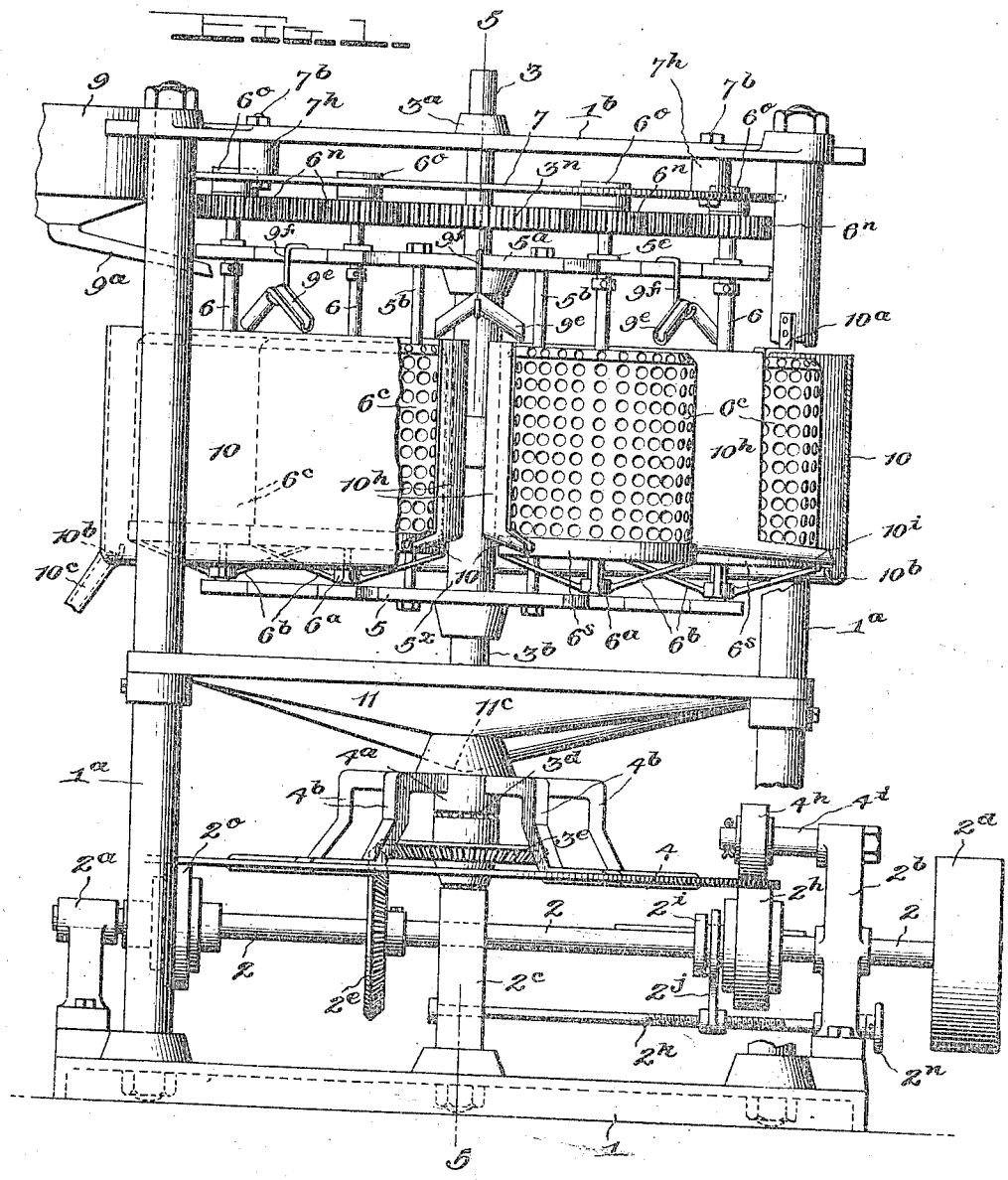
CENTRIFUGAL DRYING APPARATUS.

APPLICATION FILED JAN. 17, 1914.

1,123,536.

Patented Jan. 5, 1915.

4 SHEETS—SHEET 1.



Witnesses

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4 SHEETS—SHEET 2.

Fig. 2.

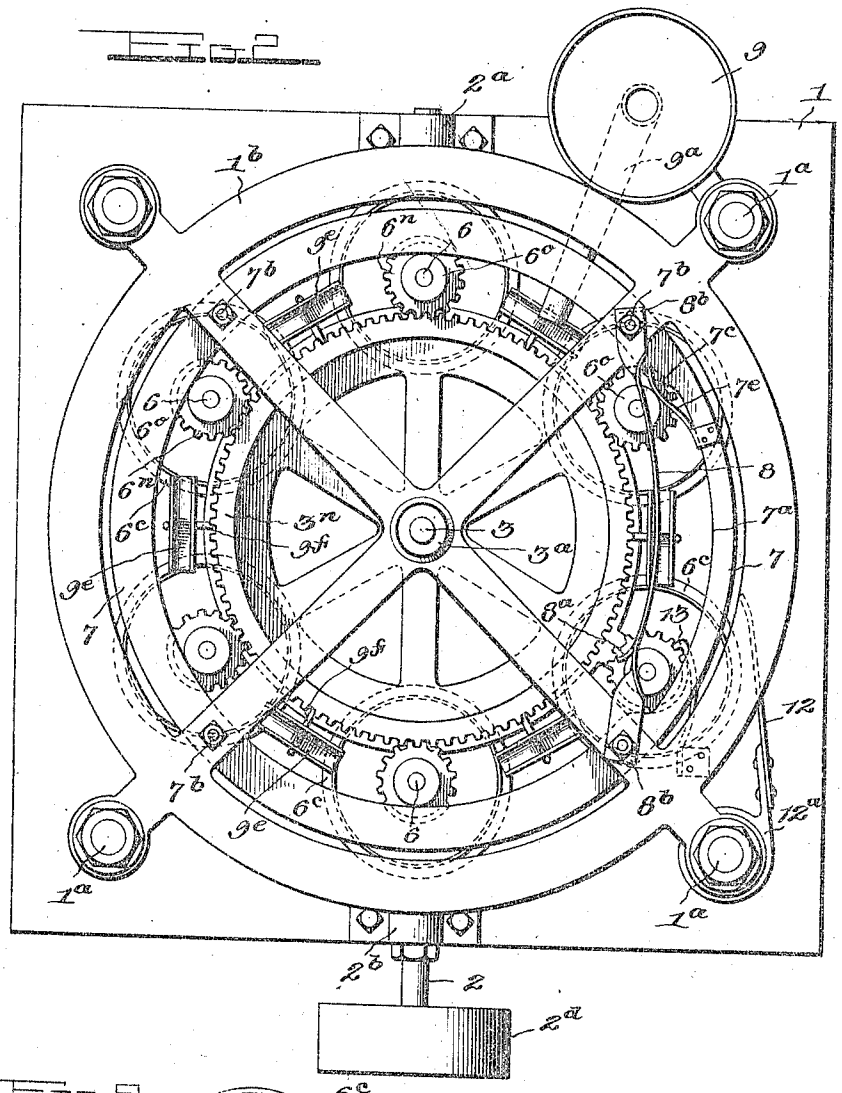
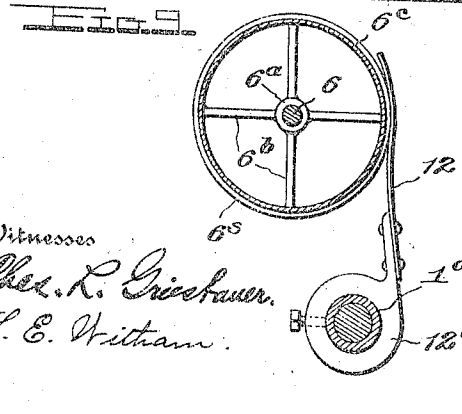


Fig. 3.



Witnesses

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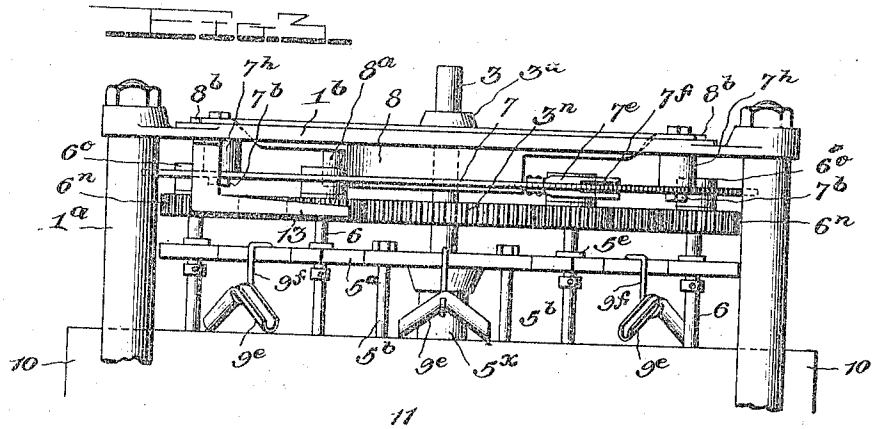
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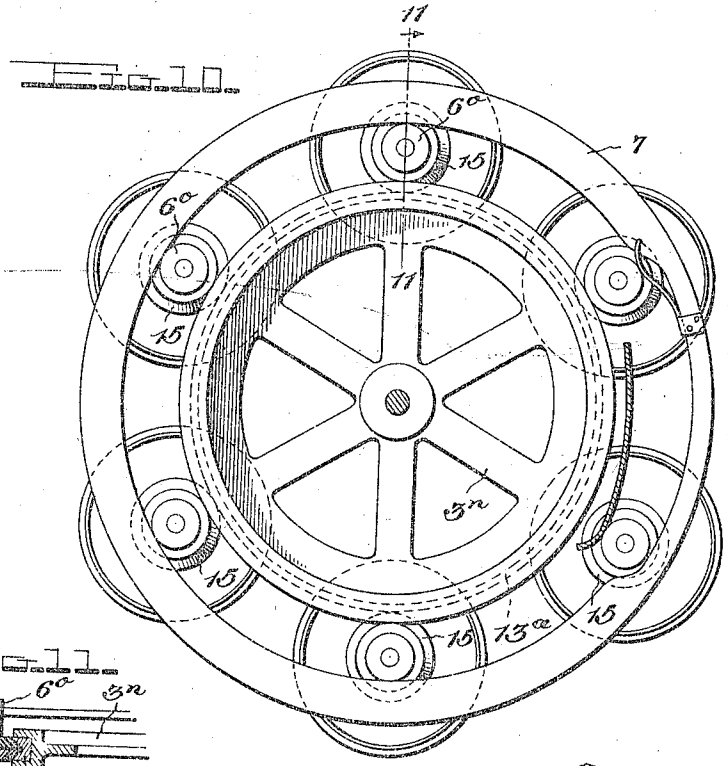
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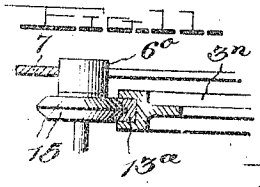
1,123,536.

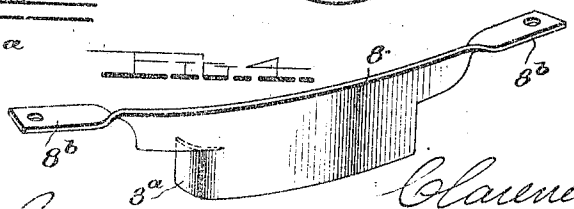
Patented Jan. 5, 1915.

4 SHEETS—SHEET 3.









Witnesses

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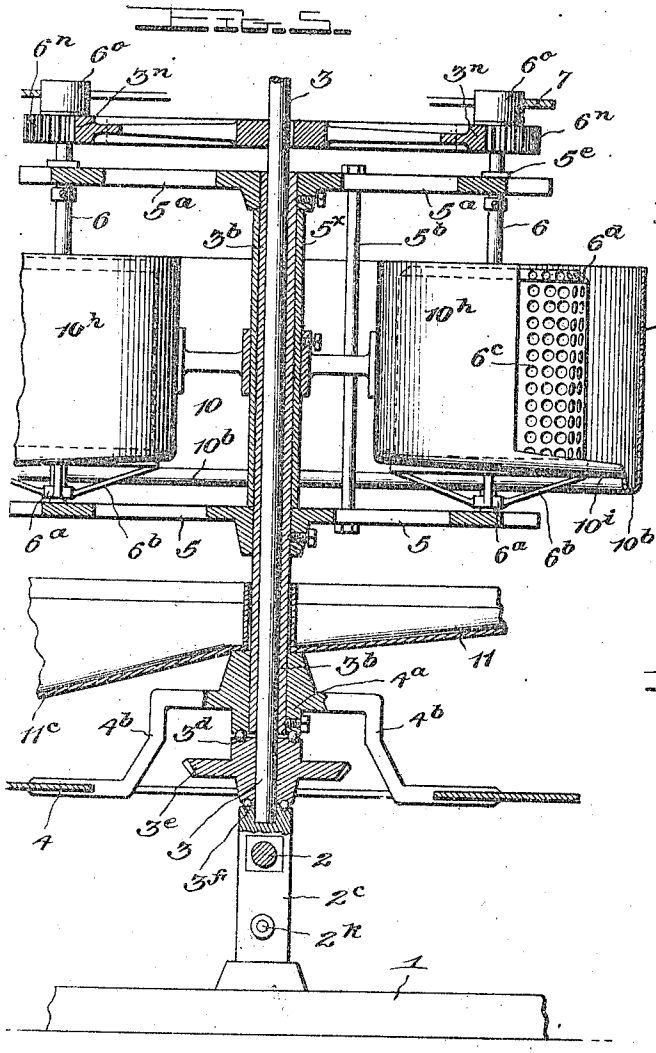
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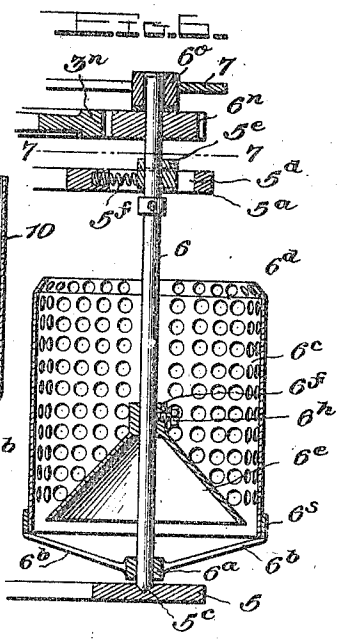
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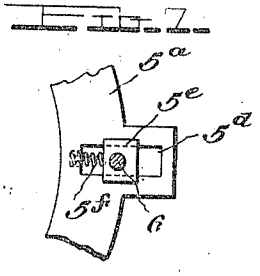
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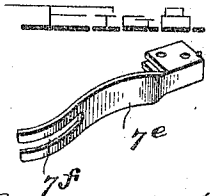
Patented Jan. 5, 1915.

4 SHEETS—SHEET 4.









Witnesses

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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL DRYING APPARATUS.

1,123,536. Specification of Letters Patent. Patented Jan. 5, 1915.

Application filed January 17, 1914. Serial No. 812,845.

To all whom it may concern:

Be it known that I, CLARENCE W. HOWARD, a citizen of the United States, residing at Fort Madison, in the county of Lee and State of Iowa, have invented certain new and useful Improvements in Centrifugal Drying Apparatus; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is a novel apparatus or machine for drying substances by centrifugal action, and is what I term a centrifugal drying machine, and is especially adapted for drying small particles in bulk, such as grain, button blanks, and other large materials, but by using drying cylinders of suitable mesh it can be used for drying fine materials such as sand, sugar, etc.; and it may also be used in the separation of pulpy matters. It is, however, more particularly designed for use in rapidly drying granular substances such as grain.

One object of the invention is to provide a machine in which the material can be dried very rapidly by centrifugal action, and which can be operated continuously, so that the material to be dried can be continuously fed to the machine and separated from the water or liquid and the dried material continuously discharged, and for this purpose my machine is provided with a series of drying cylinders which are adapted to be simultaneously moved in an orbital path, and during part of its traverse of such path each drying cylinder is caused to rotate on its own axis so as to effect the drying of the material therein by centrifugal action, and is then stopped from rotating on its own axis without stopping its orbital movement, and the dried material is discharged therefrom at the desired point; then such drying cylinder is again caused to rotate upon its own axis and while so rotating receives a fresh charge of the material to be dried, and dries the same, and discharges it as before, in the course of its orbital travel.

My invention also includes novel means for arresting the rotation of each drying cylinder at a certain point in its orbital movement and for bringing it again into axial rotation at another point in its orbital movement.

It also includes a novel construction of the drying cylinders.

In the accompanying drawings I have illustrated one practical embodiment of the invention which I will describe in detail to enable those familiar with the art to manufacture and use the same, and in the claims I have summarized the novel features and combinations of parts for which I desire protection.

In said drawings:—Figure 1 is a front elevation of the complete machine, partly broken to more clearly show some of the features of construction. Fig. 2 is a top plan view of Fig. 1. Fig. 3 is a detail side view of the upper part of the machine showing the devices for throwing the drying cylinders into and out of axial rotative position. Fig. 4 is a detail view of the guard plate 8. Fig. 5 is a detail vertical section on the line 5—5, Fig. 1. Fig. 6 is an enlarged vertical sectional view through one of the drying cylinders and the immediately related parts. Fig. 7 is a detail view of the upper bearing of a drying cylinder. Fig. 8 is a detail view of the spring 7^c. Fig. 9 is a detail view of the frictional devices for arresting the rotation of the drying cylinders. Fig. 10 is a detail top plan view illustrating a frictional drive for the cylinders. Fig. 11 is a detail section of Fig. 10.

As shown in the drawings, the machine frame comprises a base 1 of any suitable contour, from which rise four standards 1^a that are connected at top by a frame or spider 1^b to hold them in rigid relation. These parts may be united in any suitable way, threads and nuts being shown for such purpose in the drawings.

On the base 1 are mounted bearings 2^a, 2^b, for a horizontal shaft 2, which extends diametrically across the base and through a central standard 2^c that is disposed at about the vertical axis of the frame; and in the upper end of the standard 2^c is stepped a vertical shaft 3 (see Figs. 1 and 5), the upper end of which shaft is journaled in a bearing 3^a in the top frame 1^b.

Shaft 2 may be driven by any suitable means, being shown as provided with a pulley 2^d, on one end by which it can be belted to a driving shaft (not shown). The shaft 3 stands vertically above shaft 2 and is driven from shaft 2 by means of a bevel gear 3^e meshing with a bevel gear 2^e on shaft 2, Fig. 1. On the shaft 3 above gear 3^e, is loosely placed a sleeve 3^b, to the lower end of which is rigidly attached the hub of

a horizontally disposed friction wheel, which preferably comprises an annular rim 4, a hub 4^a and connecting spokes 4^b, which spokes are preferably bent so that the rim 4 lies in a plane below the gear 3^e, while the hub 4^a is fast to the lower end of the sleeve 3^b above the gear 3^e. The sleeve 3^b and friction wheel may be supported upon the gear 3^e by means of ball bearings, indicated at 3^d, of any suitable construction so that the friction wheel and sleeve 3^b can turn upon, and independently of, the shaft 3. If desired, the gear 3^e may be similarly supported by roller bearings 3^f on the standard 2^e so as to lessen the friction due to the weight of superposed parts.

On the shaft 2^e may be keyed a slidable friction pulley 2^h adapted to contact with the under side of the rim 4 of the friction wheel and rotate the latter. The wheel 4 may be held down so as to frictionally contact with the pulley 2^h by means of an idler 4^h on a stub shaft 4^i attached to the bracket 2^b above the shaft 2, as shown in Fig. 1.

The friction pulley 2^h may be keyed to the shaft 2 as shown, and be adjustable longitudinally of said shaft by means of a yoke 2^j engaging a grooved collar 2^i on the hub of the pulley, and this yoke be supported on a screw shaft 2^k that may be rotatably mounted in and between the brackets 2^b and 2^c, (see Fig. 1,) and which can be adjusted by means of a hand wheel 2^n on its outer end. By adjusting the pulley 2^h radially of the friction wheel the relative speed of rotation of the shaft 3 and the sleeve 3^b can be varied.

On the shaft 2, at the side of gear 2^e, opposite the friction pulley 2^h, may be an idler pulley 2^o adapted to support the adjacent portion of the friction wheel 4 and prevent tipping of the same under the pressure of the friction pulley 2^h.

On the sleeve 3^b above the friction wheel 4 is mounted two spider frames 5, whose hubs may be fastened to the sleeve 3^b by bolts or other suitable means; and these hubs may be spaced apart by means of a tube 5^x surrounding the sleeve 3; and the spiders are rigidly connected by means of tie bolts 5^b. The lower spider 5 is provided with bearings or sockets 5^c, which may be rounded or tapered at bottom as shown in Fig. 7, in which are stepped the lower ends of the vertical shafts 6 of the drying cylinders hereinafter referred to. The upper spider 5^a is provided with radial slots 5^d, vertically above the bearings 5^c, in which slots are radially movable boxes 5^e in which the upper parts of the shafts 6 may be journaled, shafts 6 extending above said boxes (see Figs. 6 and 7.) The boxes may be normally forced outward by means of springs 5^f for the purpose hereinafter explained.

A hub 6^a is secured to each shaft 6 above the bearing 5^c in any suitable manner, and has radially projecting and preferably upwardly bent arms or spokes 6^b, the outer ends of which are connected to the lower end of a cylinder 6^c, which is preferably formed of foraminous sheet metal, but may be of any other suitable material (Fig. 6). This drying cylinder 6^c is thus rigidly supported on and connected to the shaft 6, and the upper end of this cylinder is preferably slightly contracted by bending the upper edge of its walls inward, as indicated at 6^d. Attached to the shaft 6 within the cylinder 6^c is a cone 6^e the base of which is of less external diameter than the internal diameter of the cylinder. The apex of this cone may be attached to a collar 6^f secured to the shaft by a set screw 6^h, or other suitable means (Fig. 6). The cone is so adjusted that its base is very near the lower end of the cylinder, and by this cone the bottom of the drying cylinder is partially closed, but the mouth or upper end of the cylinder is open.

On the shaft 6, above the spider 5^a, is attached a pinion 6^n adapted to mesh with a master gear 3^n fastened to the shaft 3, above the spider 5^a, and when the pinion and gear are in mesh the drying cylinders will be rotated on their axes and at the same time have an orbital movement around the shaft 3 by the rotation of the spiders, imparted by the friction gearing.

On the upper end of each shaft 6, above the pinion 6^n, is an idler roller 6^o which is adapted to contact with the inner edge of a circular cam plate or ring 7 suspended from and rigidly connected to the top frame 1^b by means of bolts 7^b, and spacing sleeves 7^h, as indicated in the drawings. The major portion of the inner periphery of this ring 7 is concentric to the master gear 3^n, so that when the rollers 6^o are engaged with such portion of the plate, the pinion 6^n will be held in mesh with the master gear 3^n, but one point of this ring is cut away, as indicated at 7^a, (Fig. 2) and when a drying cylinder reaches the outer end of this part of the plate and the roller 6^o on its shaft 6 enters the cut-away portion 7^a of the plate, the spring 5^f will move the box 5^e outward sufficiently to disengage its pinion 6^n from the master gear 3^n. The box 5^e may be capable of slight rocking motion in the longitudinal plane of the slot 5^d so as to permit the necessary slight swinging motion of the shaft 6. When the roller 6^o reaches the other end of the cut-away portion 7^a it contacts with a cam surface 7^c on the ring, which causes it to move back to normal position and reëngage the pinion 6^n with the master gear 3^n. To prevent danger of clash of the gear and pinion teeth at this point, I preferably provide a flat spring 7^e (see Figs. 2 and 8), which

may be attached to the ring 7, or other suitable support, and which preferably has its end notched at 7^f so as to extend above and below the cam portion 7^c of the plate (see Figs. 3 and 8), and which will be engaged by the roller 6^o of the drying cylinder moving thereby and force the roller inward with a yielding pressure until its pinion 6^n comes into engagement and proper mesh with the teeth of the master gear 3^n. In the construction shown in the drawings I have illustrated these drying cylinders arranged in concentric series around the shaft 3, and the cut-away portion 7^a of the ring preferably extends for about one-fourth the circumference of the ring 7. In order to insure disengagement of the pinions 6^n from the master gear 3^n, when the drying cylinders are moving past the cut-away portion 7^a, I provide a guard plate 8 which may be attached to the top frame 1^h by means of end pieces 8^b, bolted to said plate as shown in Fig. 2; the body of said plate being curved to substantially correspond to the inner curvature of the ring 7; and said plate has on its forward end, toward which the pinions 6^n move, an inwardly bent cam portion 8^a, which projects into the path of the rollers 6^o and will tend to cause them to move outwardly and thus positively disengage the pinions 6^n from the master gear 3^n. The other end of the plate 8 is cut away adjacent the spring 7^e so as not to interfere with the action of the spring 7^e and cam 7^c in returning the pinions 6^n into engagement with the master gear 3^n.

Material may be supplied to the drying cylinders from a hopper 9 mounted at one side of the machine and provided with a discharge spout 9^a that extends inwardly to a point below the spider 5^a and in such position that the material discharged from the spout will enter the open upper ends of the drying cylinders passing thereunder. In order to prevent the material falling between adjacent drying cylinders while passing the spout I provide double inclined chutes 9^c which are supported on brackets 9^f secured to the spider 5^a intermediate each adjacent pair of drying cylinders and in such position that the chutes pass beneath the spout 9^a and receive the material therefrom which would otherwise drop between adjacent cylinders, and such material is directed by these chutes into the respective drying cylinders.

While I have shown and described the use of toothed gearing for rotating the drying cylinders on their individual axes, I do not restrict myself to the use of such gearing as any other suitable form of driver may be employed. I contemplate in practice using frictional gears instead of toothed gears; and as indicated in Figs. 10 and 11 I may make the master gear with a grooved frictional surface 13^a in its periphery, and provide shafts 6 with friction pinions 15 to obtain increased frictional contact surface between the gear and pinions when the latter are moved into contact with the gear and held in contact therewith by the rollers 6^o and ring 7.

In order to catch the water which is ejected from the cylinders during the drying operation, the machine may be provided with an annular curtain 10 which may be supported by brackets 10^a attached to the uprights 1^a, or in any other suitable manner, and which extends from a point above the tops of the drying cylinders to a point below the same, and the lower end of this curtain is preferably provided on its inner side with a gutter 10^b, that is preferably inclined so that all the water collected on the curtain and in the gutter will run off by gravity to the discharge spout 10^c by which it may be conducted away from the machine. If desired each drying cylinder may also be partially surrounded by a curtain 10^h (Figs. 1 and 5) which is provided at its lower end with a gutter 10^i that leads to a discharge spout 10^c that projects outward sufficiently to discharge the water into the gutter 10^b so that the interior of the machine will be kept dry as well as the exterior and all the separated water or liquid will be conducted off.

Below the spider 5 is mounted an apron 11 which may be supported on the adjacent uprights 1^a, and which is preferably made conical and tapering to a discharge spout 11^c by which the dried material admitted into the apron from the drying cylinders is discharged from the machine.

When the machine is in operation the drying cylinders are rotated at great speed when they reach the recess 7^a in the ring 7; and the rotation of the cylinders must be stopped in order to dump the material. For this purpose I prefer to use friction devices, and have shown a brake spring 12 attached to a bracket 12^a on one of the uprights 1^a adjacent the entrance end of the cut-away portion 7^a, and this spring is adapted to engage the lower end or outer side of the drying cylinders as they reach this point and will by friction arrest their rotation. The cylinders may be provided with annular bands 6^s at their lower ends to engage the frictional brake 12. I may also provide a spring catch 13 attached to the parts 1^h or on the adjacent part of the frame, and extending into position to frictionally engage the pinion 6^n on the shaft of the drying cylinder and arrest the latter by engaging the teeth thereof so that the cylinders will stop their axial rotation while they are traversing the cut-away portion 7^a of the ring, and as soon as the cylinders stop, or sufficiently slow down their speed, the

material therein will drop by gravity onto the apron 11 and be discharged.

What I claim is:

1. In a centrifugal drying machine, the combination of a drying cylinder, means for moving said cylinder in an orbital path, means for axially rotating said cylinder during a portion of its orbital movement, and means for arresting its rotation during another portion of its orbital movement.

2. In a centrifugal drying machine, the combination of a series of drying cylinders, means for moving said series in an orbital path, means for axially rotating each cylinder during part of its orbital movement, and means for arresting the rotation of each cylinder during another part of its orbital movement.

3. In a centrifugal drying machine, the combination of a drying cylinder, means for moving said cylinder in an orbital path, means for axially rotating said cylinder during part of its orbital movement, means for arresting its rotation during another part of its orbital movement, and means for feeding material to said cylinder as it travels.

4. In a centrifugal drying machine, the combination of a series of drying cylinders, means for moving said series in an orbital path, means for axially rotating each cylinder during part of its orbital movement, means for arresting the rotation of each cylinder during another part of its orbital movement; means for feeding material to the series of cylinders as they travel, and means for catching the water or liquid separated from the material.

5. In a centrifugal drying machine, the combination of a rotatable support, a series of drying cylinders rotatably mounted upon said support and adapted to be moved thereby in an orbital path, means for axially rotating said cylinders during their orbital movement, means for arresting the rotation of the cylinders during part of their orbital movement to discharge the dried material, and means for catching the water or liquid and discharging the same separately from the dried material.

6. In a centrifugal drying machine, the combination of a rotatable support, a series of drying cylinders rotatably mounted upon said support and adapted to be moved thereby in an orbital path, means for axially rotating said cylinders during their orbital movement, means for arresting the rotation of the cylinders during part of their orbital movement to discharge the dried material, means for feeding material into the cylinders as they travel, and chutes intermediate the adjacent cylinders adapted to prevent material from falling between adjacent cylinders.

7. In a centrifugal drying machine, the combination of a rotatable support, a drying cylinder rotatably journaled upon said support, a master gear, a pinion on the shaft of the cylinder adapted to engage said master gear, means for holding the pinion and gear in engagement during part of the orbital movement of the cylinder, means for disengaging the pinion and master gear during another part of the orbital movement of the cylinder, and means for reëngaging the pinion and gear at the end of such portion of the movement.

8. In a centrifugal drying machine, the combination of a rotatable support, a series of drying cylinders rotatably mounted upon said support and adapted to be moved thereby in an orbital path, means for axially rotating said cylinders during their orbital movement, means for arresting the rotation of the cylinders during part of their orbital movement to discharge the dried material, means for catching the liquid separated from the dried material; a spout for feeding material into the cylinders as they travel, and chutes intermediate adjacent cylinders adapted to direct the material into the cylinders and prevent it from falling between adjacent cylinders.

9. In a centrifugal drying machine, the combination of a rotatable support, drying cylinders rotatably journaled upon said support, a master gear and pinion on the shaft of each drying cylinder adapted to engage said master gear, means for holding the pinion and gear in engagement during part of the orbital movement of the cylinder, means for disengaging the pinion and master gear during another part of the orbital movement of the cylinder, and means for reëngaging the pinion and gear at the end of such portion of the movement; means for feeding material to the cylinders during their orbital travel, and chutes located between the adjacent cylinders adapted to direct material into said cylinders.

10. In a centrifugal drying machine, the combination of a vertically disposed shaft, a master gear thereon, means for driving the vertical shaft, a sleeve loosely mounted on said shaft, and means for driving the sleeve independently of the vertical shaft; spiders mounted on said sleeve, drying cylinders rotatably mounted on said spiders, means for driving said cylinders from the master gear during part of the rotation of said spiders, and means for arresting the axial rotation of the cylinders during another part of their orbital movement by said spiders.

11. In a centrifugal drying machine, the combination of a vertically disposed shaft, a master gear thereon, means for driving the vertical shaft, a sleeve loosely mounted on said shaft, means for driving the sleeve independently of the vertical shaft,

spiders mounted on said sleeve, a drying cylinder having its shaft mounted in said spiders, a pinion on the cylinder shaft adapted to mesh with the master gear, a ring for holding said pinion in mesh with said gear during part of the rotation of said spiders, means for disengaging the pinion from the master gear during another part of the rotation of said spiders, and means for reëngaging the pinion with the master gear, substantially as described.

12. In a centrifugal drying machine, the combination of a vertically disposed shaft, a master gear thereon, gearing for driving the vertical shaft, a sleeve loosely mounted on said shaft, and gearing for driving the sleeve independently of the vertical shaft, spider frames mounted on said sleeve, drying cylinders having their shafts journaled in said spiders, a pinion on each cylinder shaft adapted to mesh with the master gear, a ring for holding said pinion in mesh with said gear during part of the rotation of said spider frames, means for disengaging the pinion from the master gear during another part of the rotation of said spider frames, and means for reëngaging the pinion with the master gear, substantially as described.

13. In a centrifugal drying machine, the combination of a vertically disposed shaft, a master gear thereon, a transverse shaft and gearing for driving the vertical shaft from the transverse shaft, a sleeve loosely mounted on said shaft, a frictional gear on said sleeve, a frictional pulley on said transverse shaft for driving said sleeve independently of the vertical shaft, spiders mounted on said sleeve, vertically disposed drying cylinders having their shafts journaled in said spiders, a pinion on each cylinder shaft adapted to mesh with the master gear, a ring for holding said pinion in mesh with said gear during part of the rotation of said spider frames, means for disengaging the pinion from the master gear during another part of the rotation of said spider frames, and means for reëngaging the pinion with the master gear, substantially as described.

14. In a centrifugal drying machine, the combination of a vertically disposed shaft, a master gear thereon, a transverse shaft and gearing for driving the vertical shaft from the transverse shaft, a sleeve loosely mounted on said shaft, gearing for driving the sleeve from said transverse shaft independently of the vertical shaft, spiders mounted on said sleeve, vertically disposed drying cylinders having their shafts journaled in said spiders, a pinion on each cylinder shaft adapted to mesh with the master gear, a ring for holding said pinion in mesh with said master gear during part of the rotation of said spider frame, means for disengaging the pinion from the master gear during another part of the rotation of said spider frames, and means for reengaging the pinion with the master gear; means for feeding material into the cylinders during their orbital movement, means for arresting the rotation of the cylinders while their pinions are disengaged from the master gear; and means for catching and directing the separated liquid discharged from the cylinders.

In testimony that I claim the foregoing as my own, I affix my signature in presence of two witnesses.

CLARENCE W. HOWARD.

Witnesses:
WILLIAM W. SHEPARD,
WILLIAM A. SHEPARD.