Aug. 21, 1928. 1,681,690

J. B. VERNAY

DRYING APPARATUS

Filed Oct. 31, 1927 2 Sheets-Sheet 1

Fig. 1

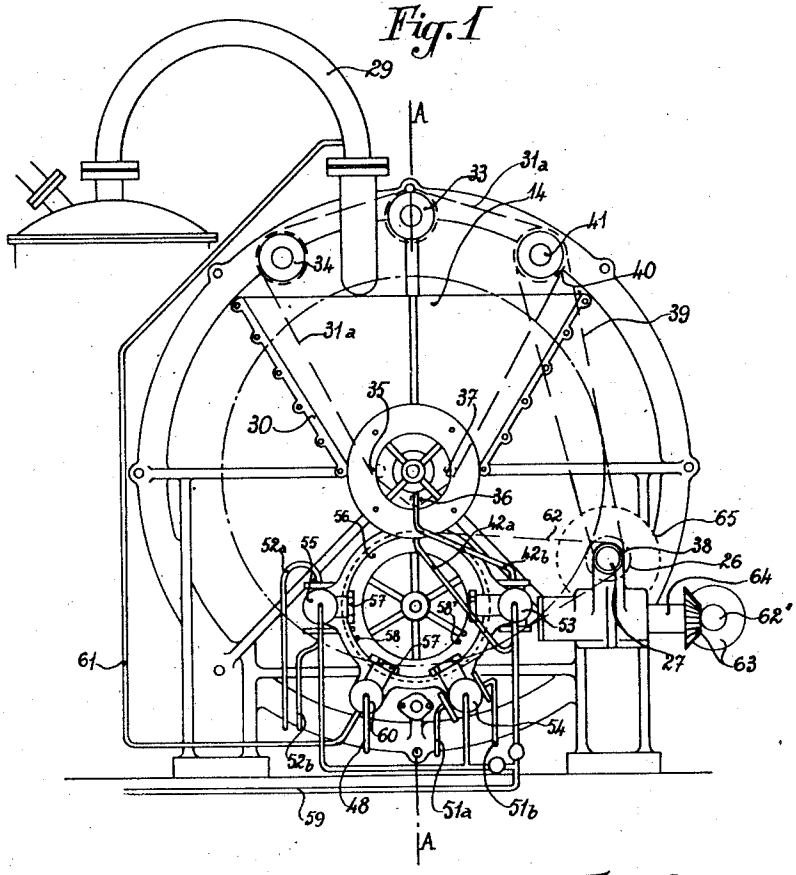
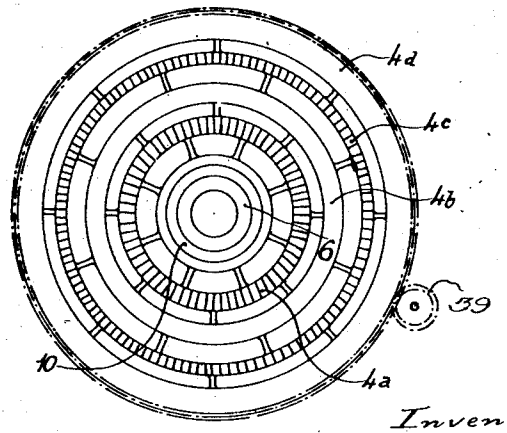


Fig. 3



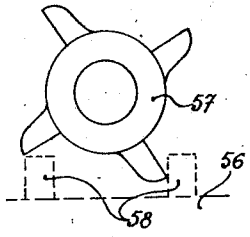


Fig. 5

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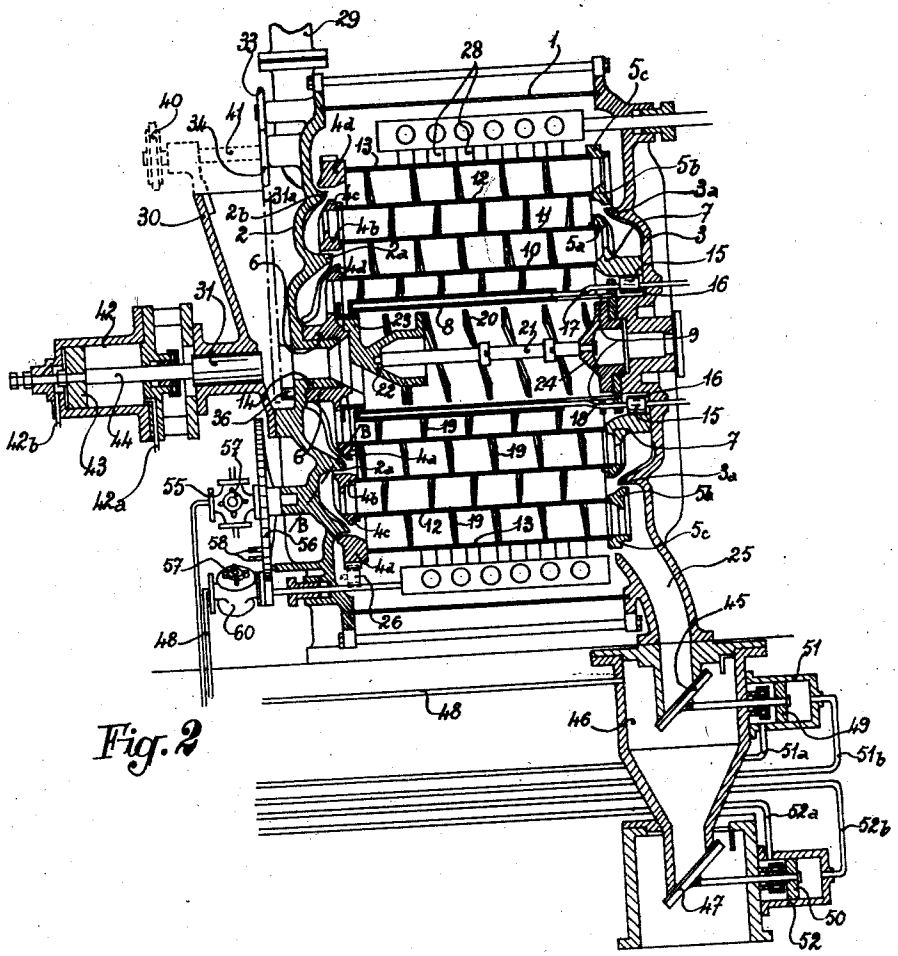


Fig. 2

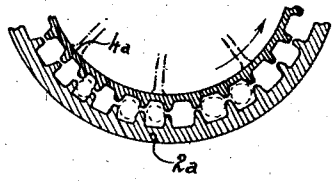


Fig. 4

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UNITED STATES PATENT OFFICE.

JEAN BAPTISTE VERNAY, OF VILLEURBANNE, FRANCE.

DRYING APPARATUS.

Application filed October 31, 1927, Serial No. 230,096, and in France December 18, 1926.

This invention refers to a drying apparatus capable of working under vacuum, of the kind described in my prior U. S. Letters Patent No. 1,628,481, and it has for its object improved means for introducing the paste to be dried into the apparatus, for heating this paste, for crushing it when it agglomerates into lumps during the drying operation and for automatically operating the apparatus.

In the annexed drawings:

Fig. 1 is a front view of the apparatus.

Fig. 2 is a section on line A A (Fig. 1).

Fig. 3 is a view of an end plate supporting the cylinders.

Fig. 4 is a diagrammatic section on line B B (Fig. 2).

Fig. 5 schematically shows the drive of a cock.

The apparatus comprises a tight casing formed of a cylindrical body 1 provided with two ends or covers 2 and 3 preferably made of cast iron. A rotatable unit or rotor consisting of co-axial cylinders is located in this casing, these cylinders being supported by two end plates.

Each end plate is made of several concentric rings connected by radial arms; the left-hand plate comprises four rings 4^a, 4^b, 4^c and 4^d and a central hub 6, while the right-hand end plate, which is similar in construction, comprises only three rings 5^a, 5^b and 5^c and a central hub 7.

The innermost cylinder 8 is not rotatable and is supported at one end by means of stays 9 which are fixed to the rear cover 3 of the casing. The other cylinders 10, 11, 12 and 13 are fixed at both ends to the successive rings of the two end plates.

The front cover 2 is provided with two internal circular ribs 2^a and 2^b. Rib 2^a projects between the rings 4^a and 4^b of the front end plate, the radial arms connecting rings 4^a and 4^b being of course conveniently curved. Rib 2^b projects also between rings 4^c and 4^d. Rings 4^a and 4^c are provided with teeth (Figs. 2 and 3) and ribs 2^a and 2^b are toothed (Figs. 2 and 3).

The hub 6 of the front end plate rotates on a hollow trunnion 14 which is integral with the front cover 2.

The rear cover 3 is provided with a circular rib 3^a which projects between rings 5^a and 5^b. Ring 5^a and rib 3^a are provided with teeth.

The hub 7 of the rear end plate rotates on rollers 15 supported by hollow shafts 16.

The innermost cylinder 8, as shown in Fig. 2, is provided with a double-wall and the annular space thus created is used for steam-heating, the inlet and outlet pipes 17 and 18 being connected with two hollow shafts 16.

The cylinders 13, 12, 11 and 10 are provided with helical guides 19 fixed to their inner faces. Cylinder 8 contains an internal rotatable helical guide 20 supported by a shaft 21, one end of which is fixed to a conical member or boss 22. This boss is fixed to the hub 6 of the front cover plate 2 by means of radial arms 23. The other end of shaft 21 is fixed to a boss 24 which rotates in the rear cover plate 3 of the casing.

The material to be dried is introduced through the axial bore of trunnion 14 and falls into the innermost cylinder 8. It is directed towards the rear end of cylinder 8 by the rotation of the helical guide 20 and falls onto the inner surface of cylinder 10. It is then directed towards the front end of cylinder 10 by the helical guide 19 and falls in front of ring 4^a onto the rib 2^a of the front cover plate 2. This rib directs the material onto ring 4^b and cylinder 11. The lumps of material are crushed by the inter-action of the teeth of ring 4^a and of rib 2^a as shown in Fig. 4. The material is then directed towards the rear end of cylinder 11, is again crushed between ring 5^a and rib 3^a, travels into cylinder 12, is crushed between ring 4^c and rib 2^c, travels into cylinder 13 and then falls over ring 5^c into a spout or hopper 25.

The rotary unit or rotor is driven by a toothed pinion 26 keyed on a shaft 27 (Fig. 1) and which meshes with the toothed periphery of ring 4^d.

The apparatus is heated by steam pipes 28 and by the double walls of the innermost cylinder 8, and vacuum is created in it by means of a pipe 29.

The material to be introduced into the apparatus is placed in a funnel-shaped hopper 30 and a piston 31 forces it into the axial bore of trunnion 14. The material tends to stick on the walls of hopper 30 and, for avoiding this, an endless chain 31^a is provided. This chain is supported by pinions 32, 33, 34, 35, 36 and 37 as shown, Fig.

1, and it is driven by shaft 27, through pinion 38, chain 39, pinion 40 and shaft 41.

The drive of piston 31 is effected by a compressed-air cylinder 42 provided with a piston 43, the rod 44 of which is connected to and actuates piston 31.

The spout or hopper 25 is closed by means of a valve 45. A second hopper 46 is provided beneath valve 45, this hopper 46 being closed by a valve 47. The valves 45 and 47 being closed, a vacuum is created in the hopper 46 (by pipe 48) and valve 45 is opened. The material from hopper 25 falls into hopper 46. Valve 45 is then closed, vacuum is suppressed in hopper 46 and valve 47 is opened. The material then falls freely into any appropriate receptacle.

Valves 45 and 47 are operated by the pistons 49 and 50 of compressed-air cylinders 51 and 52.

The operations of valves 45 and 47 and of piston 31, and the control of the pressure in hopper 46 are entirely automatic.

Cylinders 42, 51 and 52 are each provided with two pipes 42^a, 42^b; 51^a, 51^b; 52^a, 52^b. These cylinders are controlled by three-way cocks 53, 54 and 55 located, as shown, circumferentially around a disk 56 which is driven from shaft 27 by a chain 62. Each cock is provided with a four-toothed head 57 (Fig. 5) which is arranged to cooperate with studs 58 fixed on the periphery of disk 56. Cock 53 controls cylinder 42; cock 54 controls cylinder 51 and cock 55 controls cylinder 52. As shown, Fig. 1, cocks 54 and 55 are driven by the same studs 58, but cock 53 is driven by other studs 58′; this permits of regulating the operation of cylinder 42 independently of the operation of cylinders 51 and 52. Cocks 53, 54 and 55 are connected with a compressed air line 59.

A fourth cock 60 is driven by studs 58. This cock controls the pressure in hopper 46 by connecting pipe 48 either with the atmosphere (by means of a suitable hole) or with a pipe 61 which leads to the main vacuum pipe 29.

Shaft 27 is driven from a driving shaft 62′, through a pair of bevel gears 63, a shaft 64 and a worm gear (not represented), which drives a wheel 65 keyed on shaft 27.

When the driving shaft 62′ rotates, the disk 56 is rotated and, by means of the controlling cocks, actuates the compressed-air cylinders. The material is forced into the apparatus by the strokes of piston 31 and, after being dried falls into spout 25 and is evacuated, as above explained, by the operation of valves 45 and 47. It is to be noted that the material in hopper 30 fills the same to a point above the inlet trunnion 14 and, because of its pasty character, tends to stick together and thus form a tight seal of the apparatus.

The teeth of rings 4^a, 4^c and 5^a and of ribs 2^a, 2^b and 3^a are preferably so dimensioned that the first crushing set (ring 4^a and rib 2^a) breaks only the biggest lumps of paste, the second set breaking the lumps of average size and the last set, the smallest lumps.

Apparatus could, of course, be devised which would be provided with more than four rotating cylinders. The number of crushing sets would be correspondingly increased.

What I claim is:

1. A drying apparatus comprising in combination a tight casing; rotatable co-axial cylinders therein, said cylinders providing a zig-zag path for the material to be dried; and end plates for supporting said cylinders, said end plates being formed of concentric rings connected together by means of radial arms.

2. A drying apparatus as claimed in claim 1, wherein the tight casing comprises a substantially cylindrical body and two end covers supporting the end plates, said end covers being provided with circular ribs projecting between two consecutive rings of said end plates for the purpose of directing the material, which falls from a cylinder, onto the next one of larger diameter.

3. A drying apparatus comprising a tight casing formed of a substantially cylindrical body and of two end covers; rotatable co-axial cylinders inside said casing; end plates supporting said cylinders, said end plates being formed of concentric rings connected together by means of radial arms; circular ribs on said end covers; said circular ribs projecting between two successive rings of said end plates; and having teeth on at least the lower portions thereof; and teeth on that one of said rings which is of smaller diameter than said rib, the teeth on said ring being adapted for cooperation with the teeth on said rib, in order to crush the pieces of material which tend to pass between said rib and ring.

4. A drying apparatus as claimed in claim 3, comprising several grinding sets disposed in the zig-zag path of the material, each set comprising a toothed fixed rib and a toothed rotatable ring, said sets being arranged to crush the material more and more finely as it approaches the outlet of the apparatus.

5. A drying apparatus formed of several co-axial cylinders providing a zig-zag path for the material to be dried, said apparatus comprising an innermost fixed cylinder into which the material is introduced, means for driving the material along said innermost cylinder from end to end, and outer rotatable cylinders.

6. A drying apparatus, as claimed in claim 5, comprising heating means for the innermost cylinder.

7. A drying apparatus, as claimed in claim

5, wherein the innermost cylinder is provided with double-walls, the annular space between said double-walls being used for steam-heating.

8. A drying apparatus comprising a tight casing formed of a substantially cylindrical body and of two end covers; coaxial cylinders therein, the innermost being fixed and the outer ones being rotatable; end plates supporting said outer cylinders; a hollow trunnion in one of said end covers for the material to be introduced therethrough; rollers supported by shafts on the other end cover; said hollow trunnion being arranged for rotatably supporting one of said end plates and said rollers being arranged for rotatably supporting the other one; and stays for connecting said innermost cylinder with said rollers-provided end cover.

9. A drying apparatus comprising in combination a tight casing; co-axial cylinders therein, said cylinders being arranged to provide a zig-zag path for the material to be dried; a bore in said casing for the material to be introduced therethrough; a hopper in front of said bore; means for forcing material from said hopper into said casing through said bore; and an endless chain traveling along the inclined walls of said hopper for preventing the material from sticking thereto.

10. A drying apparatus comprising a tight casing; co-axial cylinders therein, said cylinders being arranged to provide a zig-zag path for the material to be dried from the innermost cylinder to the outermost; means for introducing the material into said innermost cylinder; a hopper adapted to receive dried material from said outermost cylinder; a valve closing said hopper; a second hopper adapted to receive material from said first hopper when said valve is open; a second valve for closing said second hopper; and automatic means for alternately opening said valves in order to continuously discharge dried material from inside said casing.

11. A drying apparatus as claimed in claim 10, in which means are provided for connecting the second hopper with a vacuum line when the first valve is to be opened and with the atmosphere when the second valve is to be opened.

12. A drying apparatus comprising in combination a tight casing; co-axial cylinders therein, said cylinders being arranged to provide a zig-zag path for the material to be dried from the innermost cylinder to the outermost; a bore in said casing for the material to be introduced therethrough; a hopper in front of said bore; a piston co-axial with said bore; pneumatic means adapted to reciprocate said piston for forcing material from said hopper into said casing through said bore; a receiving hopper adapted to receive dried material from the outermost cylinder; a valve closing said hopper; a second receiving hopper adapted to receive material from the first hopper when the first valve is open; a second valve closing the second hopper; pneumatic means for operating said valves; controlling cocks for said pneumatic piston and valve operating means; a pipe connected with said second hopper; a controlling cock for connecting said pipe either with a vacuum line, or with the atmosphere; and mechanical means for operating said controlling cocks in appropriate succession.

13. A drying apparatus, as claimed in claim 12, wherein the mechanical means for operating the controlling cocks comprise a continuously rotated disk; toothed heads on said controlling cocks; and actuating studs on said disk, said studs being arranged for cooperation with said toothed heads.

14. A drying apparatus as claimed in claim 12, wherein the mechanical means for operating the controlling cocks comprise a continuously rotated disk; toothed heads on said controlling cocks; and two sets of actuating studs on said heads, one of said sets of studs being arranged for cooperation with the cock controlling the pneumatic actuating means for the piston which introduces the material into the apparatus, and the other set being arranged for cooperation with the other cocks.

15. A drying apparatus comprising a tight casing; rotatable cylinders therein; rotatable end plates for supporting said cylinders; gear teeth on the periphery of one of said end plates; and a driving pinion meshing with said teeth.

In testimony whereof I affix my signature.

JEAN BAPTISTE VERNAY.