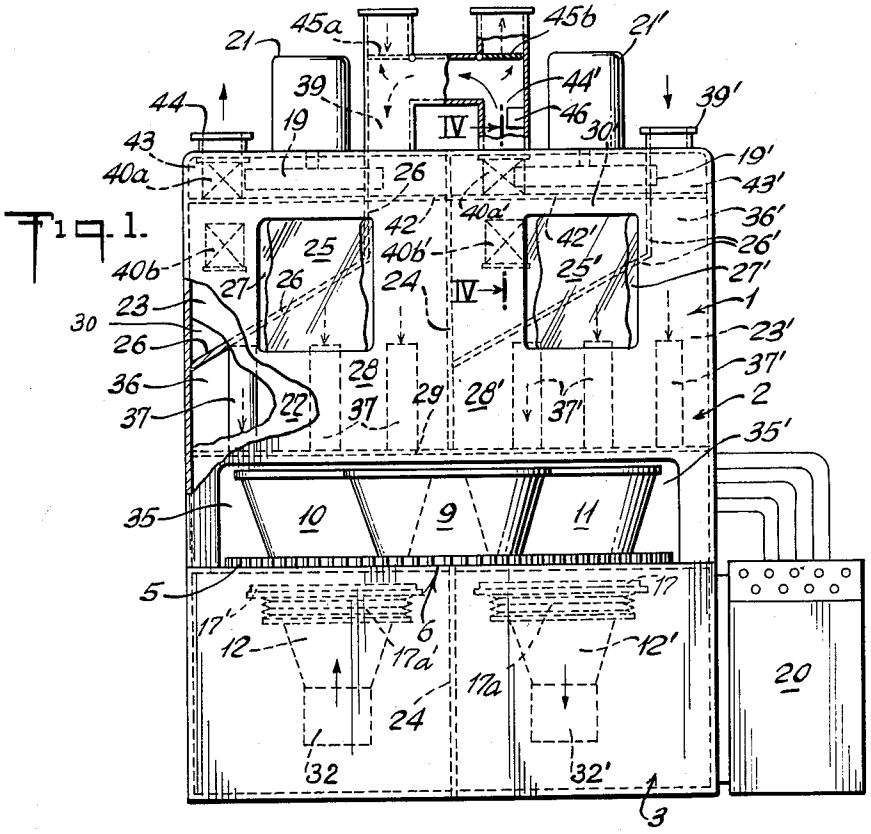
Aug. 11, 1964 W. GLATT ETAL 3,144,310

DEVICES FOR DRYING DAMP GRANULES

Filed May 2, 1961 3 Sheets-Sheet 1

Fig. 1.



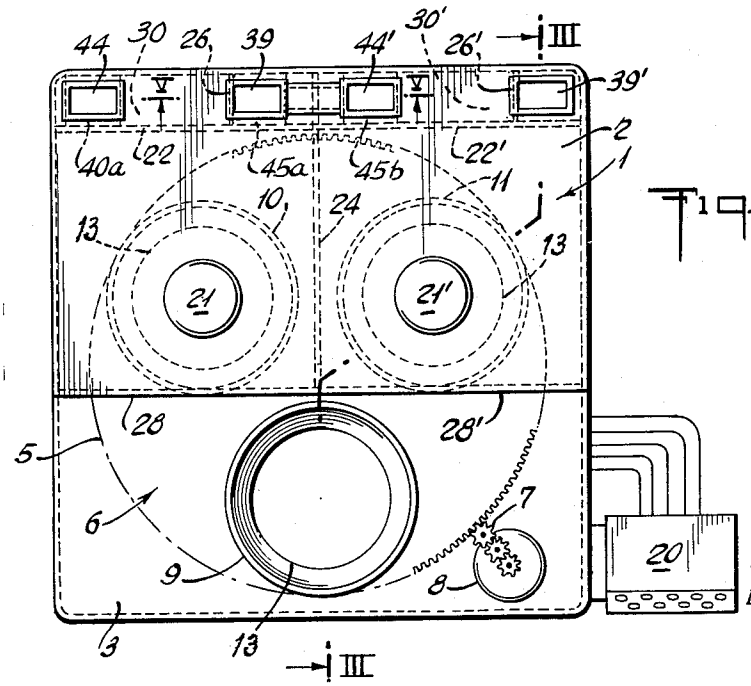


Fig. 2.

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Fig. 3.

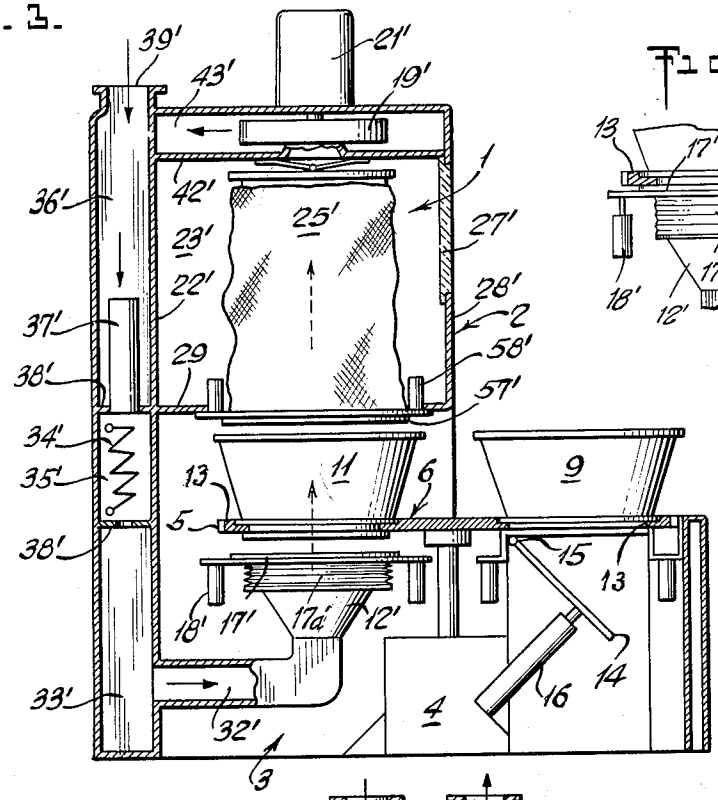
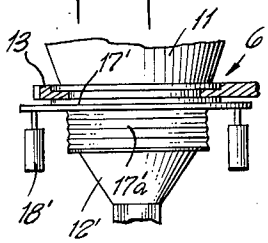


Fig. 3A.



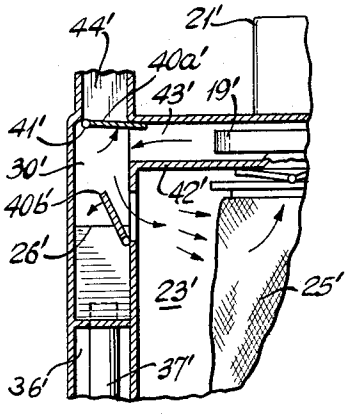


Fig. 4a.

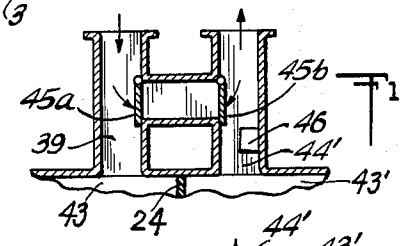


Fig. 5.

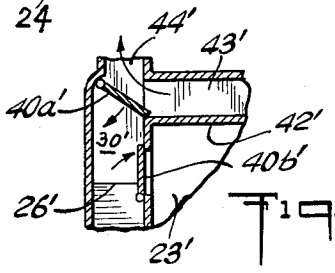


Fig. 4b.

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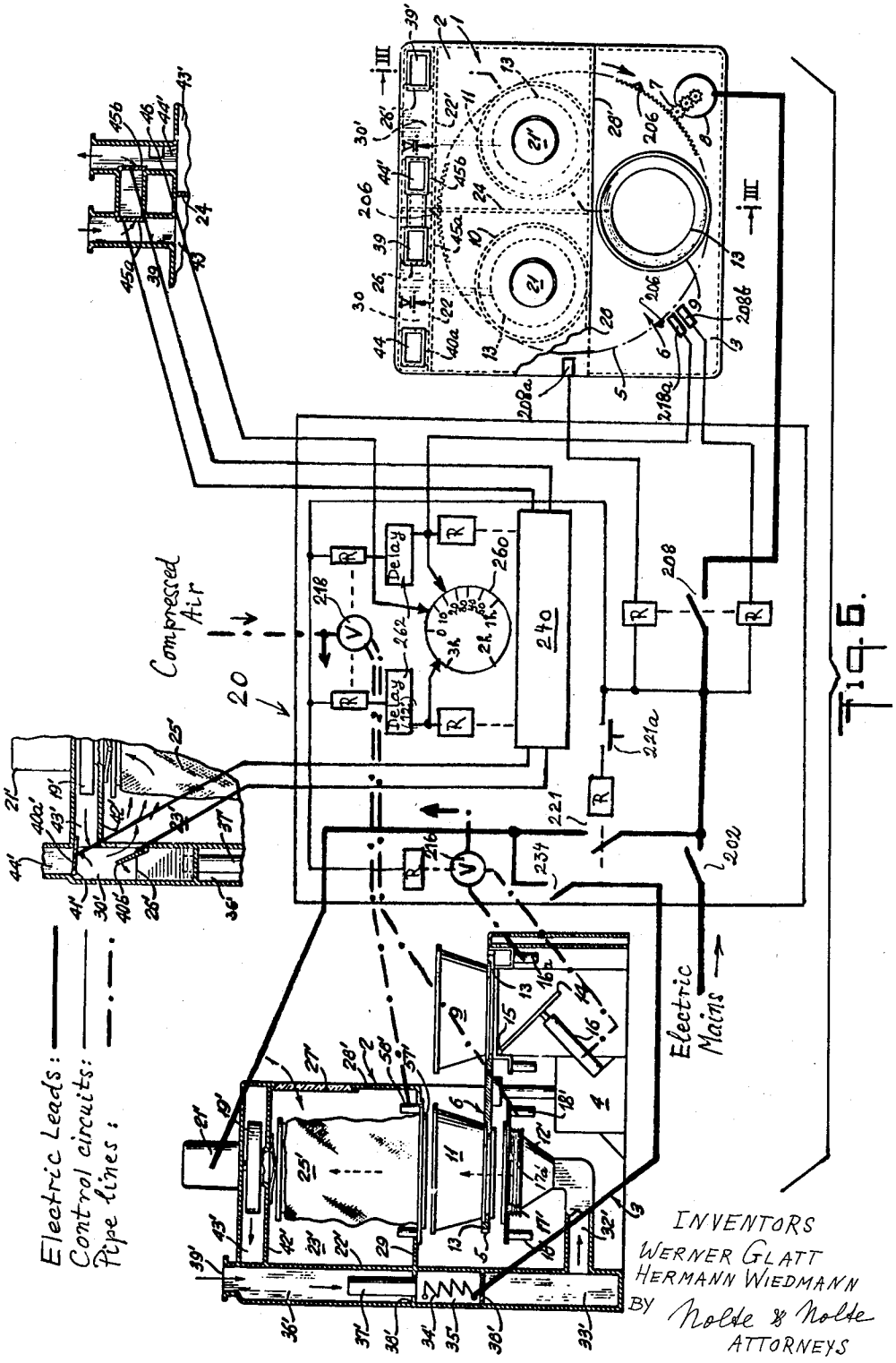

FIG. 6.

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DEVICES FOR DRYING DAMP GRANULES

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Claims priority, application Germany May 3, 1960
5 Claims. (Cl. 34—186)

The present invention relates to devices for drying damp granules and more particularly to devices wherein the material to be treated is exposed to a current of dry, hot air for removing its moisture content. Many methods are already known for drying damp granules, in which open-top and sieve-bottom containers are introduced in an air-tight manner into ducts and exposed to a dry-air current produced by a fan and by heating elements, and remain there until the product is dried. Then the air-current is interrupted and the containers taken out and replaced by new containers filled with damp granules.

Our invention represents a further development and an essential improvement of these known arrangements. The arrangement according to the invention is fit to dry 1000 kg. and more per hour, depending on the moisture content of the products. The new arrangement also contains fans and heating elements. It is one of the characteristic features that it contains at least two air ducts, each provided with a heating device and a fan; it further contains a revolving stage and removably mounted thereon a number of containers having open tops and sieve bottoms. The containers are brought into one of the air ducts by rotating the stage. The number of containers is preferably higher by one than that of the drying ducts.

The apparatus may, for instance, comprise two drying ducts and a revolving stage with three product containers. The two ducts may be operated in series or in parallel, that is, independently from one another. When the two ducts are connected in series it is possible to accomplish the drying process of the granules of one of the containers in one duct and simultaneously to pre-dry the granules of the other container in the other duct with the same drying air, whilst the third container may be replaced, emptied or filled at the same time.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a front view of a drying device according to the present invention, with parts broken away;

FIGURE 2 is a top plan view of the same arrangement;

FIGURE 3 is a sectional view according to the line III—III of FIGURE 2, substantially showing the inner structure of one-half of the device;

FIGURE 3A is a partial view of the device as shown in FIGURE 3, illustrating an alternate operative position on the sealing collars;

FIGURES 4A and 4B are partial views similar in direction to FIGURE 3 but taken both according to the line IV—IV of FIGURE 1, the two views illustrating alternate operative positions of certain elements;

FIGURE 5 is a partial, sectional view corresponding to the top center portion of FIGURE 1, with certain elements shown in their alternate operative positions; and

FIGURE 6 is a schematic illustration of the control apparatus associated with the drying device, and comprising portions of the FIGURES 2, 3, 4A and 5.

As can best be seen from FIGURES 1 through 3, the casing 1 comprises a top portion 2 and a bottom portion 3. Between the two portions there is a horizontal partition wall 29. The top portion 2 is bisected by a vertical partition wall 24 which is interrupted underneath the wall 29 as will be explained hereunder. To the left and right of wall 24, as viewed in FIGURES 1 and 2, the device has front wall portions 28, 28' provided with respective inspection windows 27, 27'. A short distance from the uppermost wall of the top portion 2, horizontal wall portions 42, 42' are provided. It will be understood that the wall portions 28, 42 and 28', 42' constitute respective left-hand and right-hand sections of the device, as viewed in FIGURES 1 and 2. The wall portions 42, 42' define, on the one hand, upper compartments 43, 43' with said uppermost wall and, on the other hand, lower or filter compartments or chambers 23, 23' with the wall 29.

The compartments 43, 43' and 23, 23' do not extend the full depth of the device since the top portion 2 also has vertical partition wall portions 22, 22' a short distance from the rearmost wall of the top portion. As best seen in FIGURES 1 and 2, the spaces between said rearmost wall and the wall portions 22, 22' are further partitioned by respective wall portions 26, 26'. To the left of these wall portions, the two sections of the device have respective compartments 30, 30' while to the right of said wall portions, there are filter chambers 36, 36' which widen toward their bottom portions. In the center of the bottom portion 3 a bearing 4 is arranged for revolving stage 6 which is arranged at the location where the wall 24 is interrupted, and is provided with a toothed rim 5. This toothed rim meshes with a pinion 7 driven by a motor 8. It will be understood that the drive of the revolving stage 6 can also be effected by compressed air or by a pneumatic hydraulic mechanism.

The revolving stage 6 has three openings 13 each of which is capable of receiving one of three removable containers 9, 10 and 11; each container is open on top and provided with a sieve bottom. In the position shown in the figures, the containers 10 and 11 are positioned above the air funnels 12 and 12', respectively, while the third container 9 is above a flap 14. The flap 14 is pivotally mounted at a hinge 15 and can be opened and closed by pneumatic means 16. A rubber collar 17, 17' is fitted at the upper edges of the funnels 12, 12' which can be pressed against the revolving stage 6 by means of pneumatic means, e.g. as shown at 18', so that the containers 10 and 11 can be sealed hermetically against funnels 12, 12', respectively. Each collar has an accordion-shaped portion, denoted 17*a*, 17*a*', which allows sealing engagement between funnels 12, 12' and the respective opening 13 of the revolving stage 6. FIGURE 3 shows one of the collars, 17', in spaced-apart relation, while FIGURE 3A illustrates the interengaged position, resulting as an effect of the respective pneumatic device 18' being operated. It will be noted that the elements 12, 17 are located in the left-hand section of the device, as viewed in FIGURES 1 and 2, while the corresponding identical elements 12', 17' are seen in the right-hand section. For the sake of clarity, not all elements have been shown on both sides; for example, the left-side pneumatic means 18 is not illustrated.

In the top portion 2 of the casing 1, within the compartments 43, 43' there are axial blowers 19, 19' which are driven by electromotors 21, 21' for sucking air from the filter chambers 23, 23', respectively (see FIGURE 3). The two filter chambers are equipped with filter bags 25, 25', respectively, which are closed at the top and open at the bottom. The suspension of the bags 25, 25' from the wall portions 42, 42' is made by conventional means. The bags are visible through the windows 27, 27' (see FIGURES 1 and 3). The bottom edge of each bag, protruding through an appropriate aperture in the wall 29, is provided with a rubber collar as shown at 57' so that the containers 9–11 can be sealed hermetically against the ports of the air ducts. At 58', pneumatic means (similar to 18') is shown for pressing the collar 57' against the top of the container.

The funnels 12, 12' are connected with ducts, such as 33', through intermediate ducts 32, 32', which are connected with heating chambers 35, 35' provided with heating elements as shown at 34'; these are heated electrically or by steam or hot water. Above the heating chambers 35, 35' the filter chambers 36, 36' are closed by bottoms such as 38' having openings adapted to receive air-inlet filters 37, 37'. The top portions of the filter chambers are provided with suction pipes 39, 39' leading to the open air. The compartments 43, 43' housing the fans or blowers 19, 19' are connected to respective exhaust pipes 44, 44'.

The pipe 44' of the right-hand section of the drying arrangement and the adjoining suction pipe 39 of the left-hand section are provided with flaps 45*b* and 45*a*, respectively, adapted to be opened to the outside air or to interconnect the pipe sections 39 and 44' with each other. The flap 45*a* is preferably linked (not shown) to the flap 45*b* so that both pipes are simultaneously opened to the atmosphere, or connected with one another.

As can best be seen from FIGURES 4A and 4B, there are control flaps 40*a*, 40*a*' between the respective blower compartments 43, 43' and the exhaust pipes 44, 44'. Preferably linked to said flaps by conventional mechanical or electrical means (not shown), are separate control flaps 40*b*, 40*b*' which are adapted to interconnect the compartments 30, 30' with the filter chambers 23, 23'. All the said flaps, including the flaps 45*a*, 45*b* discussed somewhat earlier, are pivotable around hinged axes as shown at 41' for flap 40*a*'. It should be mentioned in this connection that the left-side counterparts of elements 33', 34', 38', 41', 57' and 58' are not shown in the drawings for the sake of clarity. The co-operation of the various flaps and chambers will be described in detail somewhat later. Control flaps 45*a*, 45*b* are best seen in FIGURE 5 wherein they provide two separate paths for the drying air paths; the other operative position is shown in FIGURE 1, wherein said flaps force the air current sequentially to pass through the ducts.

The left-side section of the top portion 2 is constructed analogously to the right-side section. The compartment 43 in which the fan or blower 19 is lodged communicates with pipe 44 over the control flap 40*a*. The air compartment 30 and the filter chamber 23 can be interconnected by the control flap 40*b* coupled with the control flap 40*a*, interconnecting said compartments when the control flap 40*a*, closes the exhaust pipe 44. In the filter chamber 36 there are fitted the fresh air filters 37, and in the heating chamber 35 underneath there are the heating elements 34.

As shown, the drying device consists of two independent drying ducts. The first one is used for performing the drying process and consists of the suction pipe 39', the fresh-air filter chamber 36', the heating chamber 35', the ducts 33' and 32', the funnel 12', the filter bag 25', the filter chamber 23' for the outgoing air and the blower compartment 43'. In this drying duct the product container 11 is placed. The second duct, serving for pre-drying, consists of the suction pipe 39, the fresh-air filter chamber 36, the heating chamber 35, ducts (similar to 33', 32') connecting the heating chamber 35 to the funnel 12, the funnel 12, the filter bag 25, the outgoing filter chamber 23 and the blower compartment 43. The product container 10 is adapted to be placed in the second drying duct. The two drying ducts of the device may be used independently from one another if the flaps 45*a*, 45*b* are in their positions shown in FIGURE 5. Each section operates then with its own inlet or suction pipe 39, 39' and outlet or exhaust pipe 44, 44'. The control flaps 40*a*, 40*a*', 40*b* and 40*b*' are in the positions indicated in FIGURE 4B for this operation.

When the flaps 40*a*, 40*b* and/or 40*a*', 40*b*' are switched over to their positions shown in FIGURE 4A, the air cycle or cycles can be considered "short-circuited" with respect to the passages through chambers 35, 35', ducts 33, 33', 32, 32', the respective containers 10, 11, and filter bags 25, 25'. This operational mode is used to vibrate the filter bags on effect of the strong air current impinging on them within the filter chambers 23, 23' which are now in direct communication with the delivery side of the blowers 19, 19' through the compartments 30, 30'. Thus the particles of the dry material which may cling to the inner walls of the filter bags, owing to the upward stream of hot air during the drying process, will be shaken off and drop into the containers.

A control apparatus 20 is schematically indicated in FIGURES 1, 2 and shown in more detail in FIGURE 6, the latter incorporating partial views of FIGURES 2, 3, 4A and 5. The apparatus contains all control elements which are necessary for controlling the individual operating parts of the drying device. These are the following: A switch 208 to turn on and off the motor 8; a switch 218 for operating the pneumatic means 18' and/or 58'; a switch 240 to operate the control flaps 40*a* and 40*a*', 40*b* and 40*b*', 45*a* and 45*b*; a switch 221 to turn on and off the electromotors 21, 21'; and, optionally, other switches, e.g. one designated 234, for switching on and off the heating elements 34, 34'.

It has been found advisable to provide the control apparatus with a programming attachment, e.g., as schematically shown at 260, adapted to control the rotation of the stage 6 by 120° as soon as the granules in the container have been dried sufficiently in the right-hand section of the device. The control apparatus may also contain a control arm or disc (not shown) which successively operates the various switches.

For the sake of simplicity, FIGURE 6 only shows the most essential, aforementioned, switches, without illustrating the more intricate simultaneous and consecutive switching operations. As a matter of example, the actuation of the control apparatus 20 may involve a section of switch 240 which controls the flaps 40*a* and 40*a*' as well as the coupled flaps 40*b* and 40*b*' for short-circuiting both air cycles. Another section of switch 240 may be arranged for disenergizing, through the intermediary of valve 218, the pneumatic means, such as 18' and 58' so that the stage 6 and the containers thereon are released. Still another switch, cooperating with the switch shown at 208, and designated 208*a*, may turn on the motor 8 while the latter may be stopped by a micro-switch 208*b*, both being controlled by the revolving stage 6 itself. A further section of the control apparatus may energize said pneumatic means again to press the rubber collars such as 17' and 57' toward the stage 6 and the product containers 10 and 11; another switch section will bring back said control flaps in their initial position. Referring more particularly to the center portion of FIGURE 6, illustrating the control apparatus 20 and some of the elements contained therein, it should be pointed out that all electrical mains leads are represented by heavy lines; all electrical control cir-

cuits by regular solid lines; and all pneumatic lines (pipes) by dot-dash lines. For the sake of simplicity of illustration, the electrical lines have been shown as single lines, without so-called return branches. For the same reason, the dot-dash lines represent continuous pipe lines having the customary walls.

The electric mains connection may include a conventional cut-off switch as shown at **202**, adapted to disenergize the entire device. This is followed by switches **208** and **221** for energizing, according to the required operational cycles, the motor **8** and the fan motors **21**, **21'**. As mentioned before, switches for, and connectoins to, the other members, e.g. motor **21** or flaps **40***a*, **40***b* have not been shown in FIGURE 6. The switch **221** has a relay circuit which can manually be energized by means of push-button **221***a*.

The electrical control or relay circuits are only schematically shown. Relays are identified by the letters "R." The two relays forming part of switch system **208**, for example, are respectively controlled by micro-switches **208***a*, **208***b* which, in turn, are acted upon by pegs or cams **206** provided on the stage at about 120° apart.

The programming device **260** is schematically illustrated with a disc-type timer graduated in periods of 10 minutes and 1, 2 and 3 hours. A micro-switch **218***a* similarly operated by the cam **206** at stage **6**, winds up a motor forming part of the programming device. Between the relays acting upon the pneumatic switch **218** and those controlling the functions of switch system **240**, delay means **262** are intercalated which provide for the required (approx. 12-second) timing between subsequent functions.

In the left-hand portion of FIGURE 6, a pneumatic means **16***a* has additionally been identified which cooperates with the flap operating means **16** already mentioned. For these elements, another pneumatic switch **216** is schematically shown, with a controlling relay, although the dot-dash line has not been connected to the compressed air input.

The method of operating can be understood from the foregoing description: For normal use the flaps **45***a* and **45***b* are in the position as shown in FIGURE 1, so that the two dry-air ducts are connected serially. The two pairs of rubber collars, e.g. **17'** and **57'** are pressed toward the revolving stage **6** and to the product containers **10** and **11**, so that each container is made part of a dry-air duct. The axial blowers **19** and **19'** are now both sucking the air through the closed and serially switched ducts, as described before, so as to dry the granules in the containers. As soon as the granules in the container **11** are sufficiently dried the mechanism will be released. This release can be executed by a hand-controlled switch or by a time switch, such as the programming attachment **260**, having an adjustable drying period, or by a switch controlled by the temperature in the pipe **44'**. Any conventional control means, e.g. a thermostat as shown at **46**, may be provided for this purpose. As soon as the revolving stage **6** is turned about 120°, the container containing the dried material can be replaced by another container which has in the meantime been filled with material to be dried.

There is a possibility for pouring out the dry granules, and that is by the help of the pneumatic means **16**, by opening the flap **14**, to discharge the material in a known manner. To this end, switch **216** will control either or both of the pneumatic means **16**, **16***a*.

We claim:

1. A device for drying damp granular materials by means of a current of hot, dry air, comprising at least two ducts for the passage of said air, at least three containers for temporarily storing said material during its processing, a revolving stage having three openings at predetermined locations, means for removably supporting said containers thereat, two of said locations substantially coinciding with the major directions of said ducts while the third location serves for filling said material into one of said containers and for emptying the same therefrom, said containers having open tops and perforated bottoms for the passage of said air, said container tops and bottoms at said two locations, the respective stage openings and said major duct directions being collinearly arranged in two separate, substantially parallel paths for successive flow of said air therethrough, a filter bag closed on top and interposed in each of said ducts substantially above said containers, and inlet filter means in said ducts.

2. A device for drying damp granular materials by means of a current of hot, dry air, comprising at least two ducts for the passage of said air, at least three containers for temporarily storing said material during its processing, a revolving stage having three openings at predetermined locations, means for removably supporting said containers thereat, two of said locations substantially coinciding with the major directions of said ducts while the third location serves for filling said material into one of said containers and for emptying the same therefrom, said containers having open tops and perforated bottoms for the passage of said air, said container tops and bottoms at said two locations, the respective stage openings and said major duct directions being collinearly arranged in two separate, substantially parallel paths for successive flow of said air therethrough, a filter bag closed on top and interposed in each of said ducts substantially above said containers, inlet filter means in said ducts, and releasable and engageable sealing means in said ducts for selectively interconnecting the bottoms of said filter bags with the tops of said containers in a substantially air-tight manner, said air passing through the material in said containers substantially upward into said filter bags.

3. A device for drying damp granular materials by means of a current of hot, dry air, comprising at least two ducts for the passage of said air, at least three containers for temporarily storing said material during its processing, a revolving stage having three openings at predetermined locations, means for removably supporting said containers thereat, two of said locations substantially coinciding with the major directions of said ducts while the third location serves for filling said material into one of said containers and for emptying the same therefrom, said containers having open tops and perforated bottoms for the passage of said air, said container tops and bottoms at said two locations, the respective stage openings and said major duct directions being collinearly arranged in two separate, substantially parallel paths for successive flow of said air therethrough, a filter bag closed on top and interposed in each of said ducts substantially above said containers, inlet filter means in said ducts, and means for closing the outlet of at least one of said ducts and directing said air from the outside of the filter bag of said one duct to its inside for vibrating said filter bag and thereby shaking off particles of said material adhering to said filter bag.

4. A device for drying damp granular materials by means of a current of hot, dry air, comprising at least two ducts for the passage of said air, at least three containers for temporarily storing said material during its processing, a revolving stage having three openings at predetermined locations, means for removably supporting said containers thereat, two of said locations substantially coinciding with the major directions of said ducts while the third location serves for filling said material into one of said containers and for emptying the same therefrom, said containers having open tops and perforated bottoms for the passage of said air, said container tops and bottoms at said two locations, the respective stage openings and said major duct directions being collinearly arranged in two separate, substantially parallel paths for successive flow of said air therethrough, a filter bag closed on top and interposed in each of said ducts substantially above said containers, inlet filter means in said ducts, releasable and engageable sealing means in said ducts for intercon-

necting the bottoms of said filter bags with the tops of said containers in a substantially air-tight manner, means for closing the outlet of at least one of said ducts and directing said air to the outside of the filter bag of said one duct, and control means for operating each of said revolving stage, said sealing means, said closing means and for correlating their operation, in at least two consecutive drying cycles, so that said stage is rotated between subsequent cycles by the angular distance between two consecutive containers, said sealing means is alternately engaged before and released after each cycle, said ducts are alternately short-circuited for providing a single continuous path and separated for presenting two separate paths for said air, and so that said closing means is operated in at least one cycle for vibrating the filter bag of said one duct.

5. A device for drying damp granular materials according to claim 4, further comprising temperature-responsive means for recycling the operation of said control means in dependence of a low moisture content value of the escape air in at least one of the outlets of said ducts.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,144,310 August 11, 1964

Werner Glatt et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, line 1, and in the heading to the printed specification, lines 3 and 4, for "Hatlingen, Baden, Germany", each occurrence, read -- Haltingen, Baden, Germany --.

Signed and sealed this 5th day of January 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents