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DEHYDRATION OVEN HAVING CONTINUOUS CONVEYORS

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FIG. 2

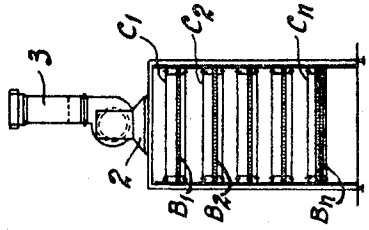

FIG. 1

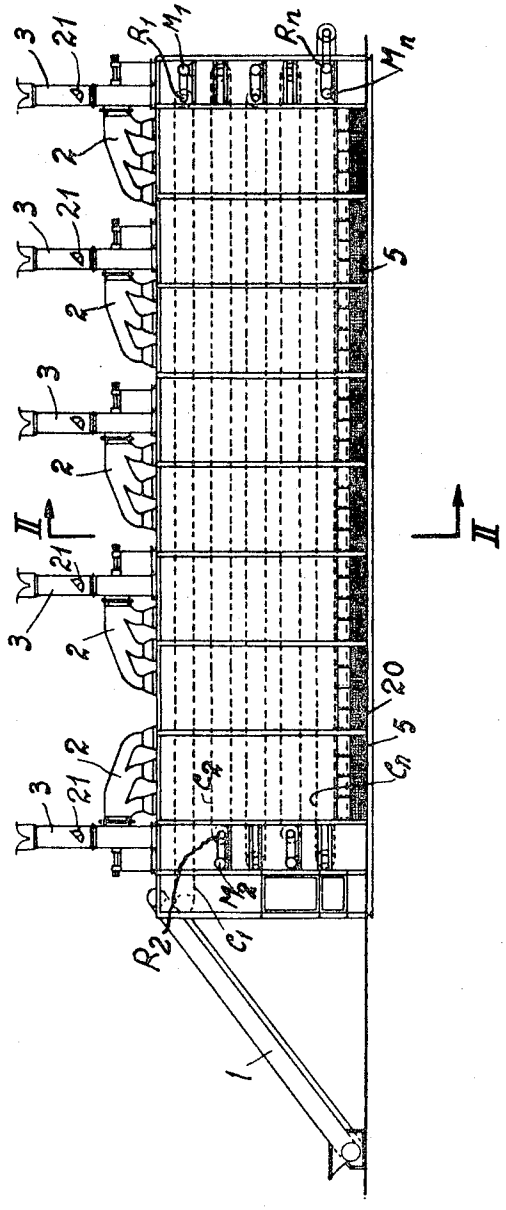

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Fig. 4

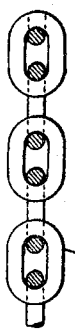

Fig. 7

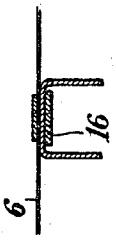

Fig. 3

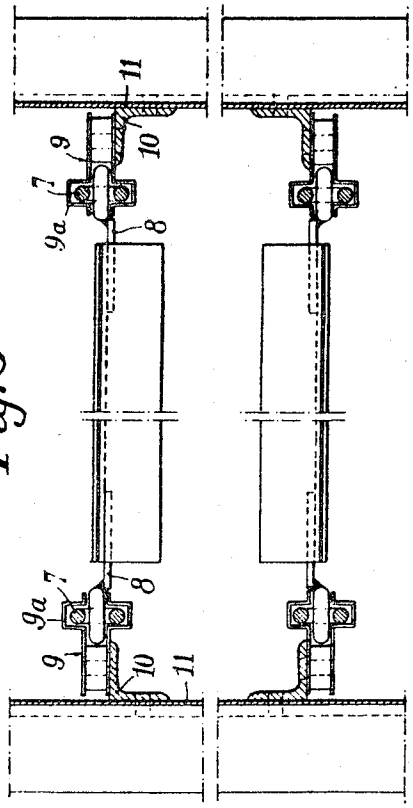

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Fig. 6

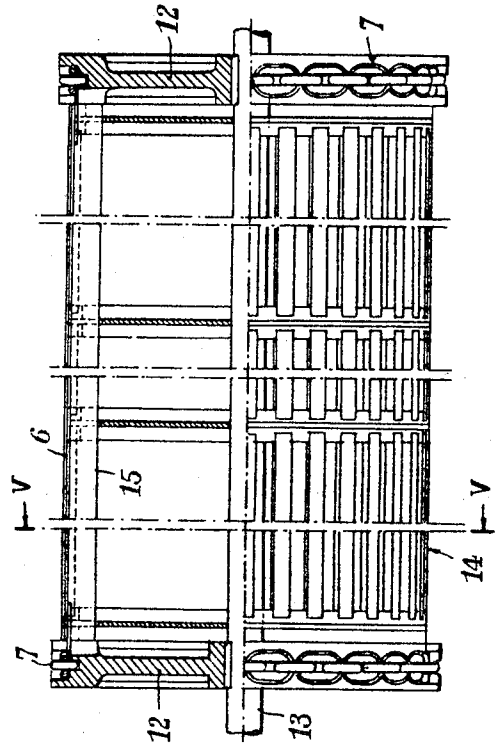
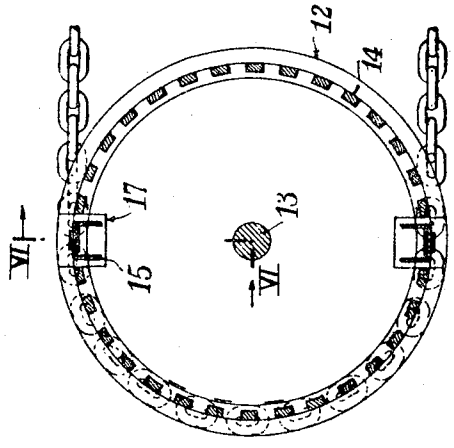


Fig. 5



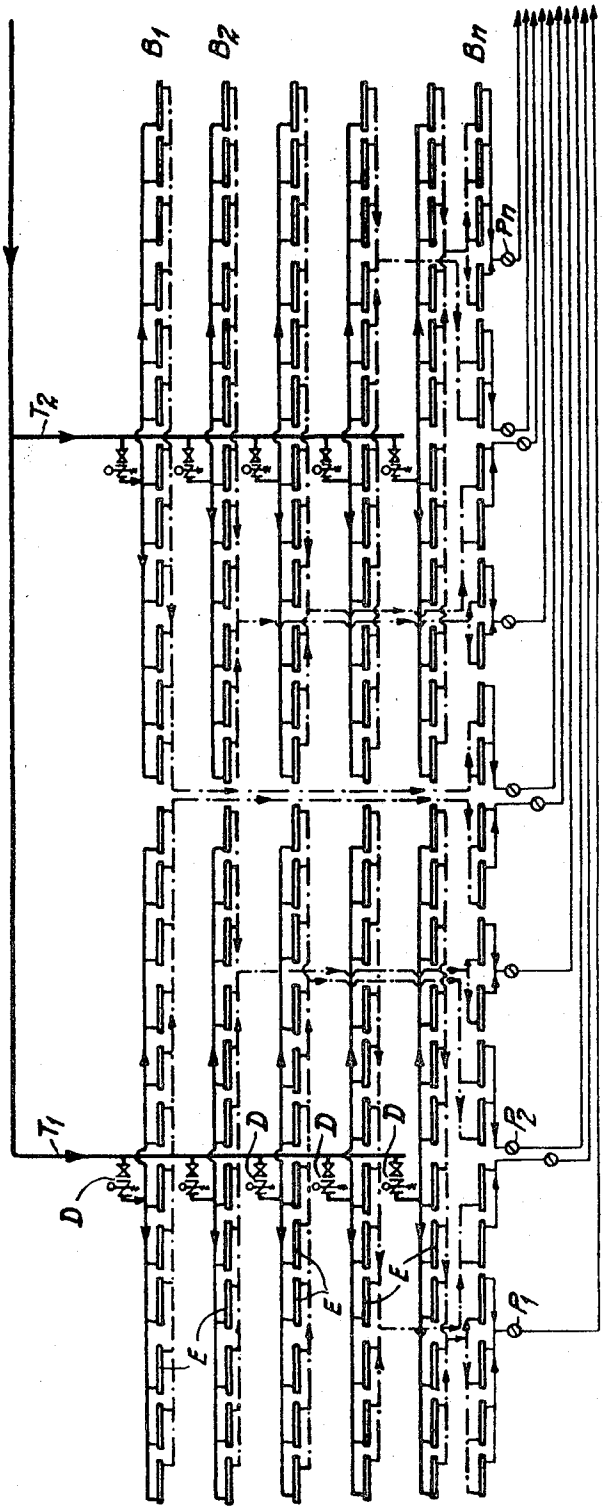


FIG. 8

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3,431,657

DEHYDRATION OVEN HAVING CONTINUOUS CONVEYORS

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Claims priority, application France, Mar. 28, 1966, 54,146; July 22, 1966, 70,555
U.S. Cl. 34—209 7 Claims
Int. Cl. F26b *21/10, 21/08*

ABSTRACT OF THE DISCLOSURE

A dehydration oven having continuous conveyors comprising heating elements mounted between the outgoing and return sides of each conveyor, the heating elements of a first portion of each conveyor being supplied with steam through a first circuit while the heating elements of a second portion of said conveyor are supplied with steam through a second circuit independent of said first circuit, the control devices for each of said circuits and each of said elements being independent, whereby the temperature, the humidity content and the air circulation can be regulated at every point of the oven.

The present invention relates to drying or dehydration ovens having continuous conveyor systems.

It is known that ovens of this kind are employed for example to carry out extensive dehydration of certain vegetables or plants and that the conditions of drying during the course of the operations must be such that the vegetable products are not allowed to ferment inside the oven and that they are not subjected to oxidation, or again to Maillard reactions in the case of sugar-containing products, such as onions, in order to make them suitable for consumption after drying.

It is furthermore well known that the more moisture there is contained in the product to be hydrated, the more it is resistant to dehydration, and that the more it is dry, the more it tends to be in equilibrium with the ambient air.

In ovens which are generally employed for this purpose, the material to be dried is admitted to the upper part, at one extremity of a first conveyor belt. During its transport on the conveyor, it is subjected to the heating action of the oven. At the other extremity of this conveyor, it is discharged on to a second conveyor belt, installed at a lower level, which in turn takes it in charge, the cycle being repeated until the conveyor mounted at the lowest level of the oven is reached, from which the dry material is evacuated to the exterior of the oven.

In order that the dehydration may be carried out under conditions as perfect as possible, it is thus advantageous if not essential with such ovens to be able to regulate the temperature at the level of each conveyor and even along the length of the same conveyor, in order to be able also to control the steam pressure inside the oven and finally to regulate the ventilation.

Ovens of known type however lend themselves badly to such regulation. In fact, on the one hand, each conveyor is generally heated by a heating element to a uniform temperature, and on the other hand the oven is only provided with a single air evacuation unit, with suction blowers and a chimney.

In addition, for the purpose of recovering part of the heat carried away by the air, it is usual to re-cycle part of this air into the oven, whereas it is well known that this air generally contains detrimental products: extracts of the actual products which have just been dehydrated.

Finally, the driving systems of the conveyors, whether

the latter are of the belt, chain-link band, perforated plate or other type, are usually driven and guided by devices comprising roller chains, simple or multiple, or conveyor chains, which interfere with the transmission of heat emitted by the heating elements and oppose the free circulation of the air.

These driving systems have the further disadvantage of necessitating toothed driving pinions and also intermediate pinions for supporting and guiding the chains. Now, ovens working at temperatures which may reach 50 to 150° C., the metals of which these mechanical members are constituted expand in a different manner according to their nature, and serious defects of operation may result in consequence.

It is furthermore necessary to provide ball or needle-bearings for these members and they must be periodically lubricated. As the bearings are mounted in the actual interior of the oven, it is clear that the grease or fatty substances employed for the lubrication absorb the dust in suspension in the surrounding atmosphere, this dust being due for example to the successive discharges of the material to be dried from the different conveyors, and is carried away by the blower of the oven. The presence of this dust is naturally a source of a large number of incidents which seriously interfere with the continuous operation of the oven and are even liable to interrupt this operation.

The invention has as an object the provision of a dehydration oven with continuous conveyors which does not have any of the above disadvantages, and in which the temperature, the humidity content and the circulation of air inside the oven can be regulated at every point of the oven.

In accordance with an essential characteristic feature of the invention, the heating elements, arranged between the outgoing and the return belt of each of the conveyors, are supplied with steam by two circuits partly independent of each other, the control devices of each of the circuits and of each of the elements being independent, so as to obtain for each conveyor two individual heating zones adjustable independently of each other and independently of those of the other conveyors.

According to a further characteristic feature of the invention, the ventilation of the oven is effected by a plurality of fans, the air intakes of which are disposed below the lower conveyor and as close as possible thereto, the air intake and the air outlet of each of the fans comprising an independent regulation system.

In accordance with a further characteristic of the invention, each conveyor comprises an independent system for controlling and/or regulating its speed.

In accordance with another important characteristic feature of the invention, each conveyor is driven by two chains of the so-called pulley-block type, arranged laterally on each side of the conveyor and rigidly fixed to it, each of the said chains being housed in a frame in the form of a shamrock, fixed on the side walls of the oven and serving as a guiding system for the conveyor.

Other characteristic features and advantages of an oven of this kind will become apparent from the description which follows below, given by way of example only and not in any limitative sense, of one form of embodiment of the invention.

In this description, reference will be made to the accompanying drawings, in which:

FIG. 1 is a diagrammatic cross-section in side elevation of the oven according to the invention;

FIG. 2 is a cross-section perpendicular to that preceding, taken along the line II—II of FIG. 1;

FIG. 3 is a diagrammatic view in transverse section of the conveyor and its driving system;

FIG. 4 is a detail view, in cross-section and to a larger scale, of a driving chain;

FIGS. 5 and 6 show the pulleys and the driving drum of the conveyor, respectively in end-view and in elevation with half-section, taken along the lines V—V and VI—VI;

FIG. 7 is a detail view given on a larger scale; and

FIG. 8 is a diagrammatic view illustrating the supply system for the heating elements of the oven.

The oven with continuous conveyors, illustrated diagrammatically in the drawings, is of a conventional type.

The material to be dried is carried into the oven by an elevator conveyor **1**, which discharges it on to one extremity of a conveyor C_1 arranged at the upper part of the oven. This conveyor carries the material in course of drying and discharges it in its turn on to a conveyor C_2 located at a lower level, and so on up to the bottom conveyor C_n, which evacuates the dry material to the exterior of the oven.

The heating is ensured by heating batteries B_1, B_2, B_n, mounted between the upper and lower sides of the conveyors. Independent blower units **2** draw the air from the bottom to the top inside the oven and evacuate it through chimneys **3**, without re-cycling it through the interior of the oven.

For the sake of simplicity of description, it will be assumed that the conveyors are constituted by endless belts **6**, it being understood that they could equally well consist of other known elements by arrangements of the invention which will be obvious to those skilled in the art.

The belt **6** is driven by two chains of the so-called pulley-block type **7**, comprising alternate horizontal and vertical links (see FIG. 4).

At regular intervals, certain horizontal links of the chain **7** are provided with horizontal lugs **8** welded on the links and fixed on the belt **6** by appropriate means, rivets, screws and nuts or the like.

The chain **7** is housed in a frame **9** of shamrock shape, fixed by angle-irons **10** to the side walls **11** of the oven. The U-shaped parts **9***a* of the angle-iron **9** ensure the guiding of the vertical links of the chain **7**, at the same time leaving it a certain lateral clearance.

Chain-pulleys **12** driven in rotation by driving shafts **13** coupled to the driving members provided outside the oven, are mounted at the two extremities of the chain **7** for driving the said chains. The pulleys **12** mounted at the corresponding extremities of the two chains **7** are coupled together by a drum **14** in the form of a squirrel cage, on which the belt **6** is supported. On this belt there are fixed transversely at regular intervals, U-shaped members **15** (FIG. 7), in which are housed longitudinal members or flat steel strips **16**, provided at regular intervals on the drum, for driving the belt **6**. The parts **15** further serve to maintain the transverse tension of the belt **6** and are engaged at their extremities in grooves **17** of the pulleys **12**.

Tests carried out with a continuous conveyor of the perforated steel plate type have proved that the device provided in accordance with the invention can drive a conveyor of this type having a width of about 2 to 4 meters, with loads of about 10 to 100 kgs. per square meter.

Each conveyor is driven by an independent motor M_1, M_2, M_n, through the intermediary of a separate reduction gear R_1, R_2, R_n (see FIG. 1).

It is thus possible independently to regulate the speed of each conveyor and to vary the total duration of the drying cycle of the products to be dehydrated from 2 hours to 15 hours, by adapting it to each particular case. This advantage is important, since it is possible to reduce the water content of the products to be dehydrated from 90% to 5% in a single drying cycle, whereas with the known drying devices the residual humidity is about 10%, so that a supplementary drying operation of the dehydrated products is necessary.

In accordance with the invention, the heating elements E of the heating batteries of each of the conveyors are supplied with hot fluid (generally steam), either through a first circuit of pipes T_1, or through a second circuit T_2, depending on whether these elements are located below a first portion of the conveyor or below the following portion, so that each conveyor comprises two successive heating zones at different temperatures (see FIG. 8). A plurality of steam-admission points is provided for each heating battery, with a pressure-reducing valve D at each point to enable the admission pressure to be regulated independently of the remainder of the circuit.

The heat resulting from the condensation of the steam at the level of each heating battery is recovered for the purpose of supplying it to the bottom battery B_n. To this end, all the drainage water is recovered at the level of each battery and is directed to the bottom battery. Independent drain-cocks P_1, P_2 . . . P_n are provided on the upstream or downstream side of the bottom battery on each drainage circuit. No drainage collector exists in the oven, and the drainage circuit ensures the return of the hot water to the boiler. This arrangement makes it possible to avoid balancing of the pressures in the various pipes, which retain their separate entities.

The air intakes **5** of the fans **3** are arranged immediately beneath the bottom conveyor C_n as close as possible to this latter, with flaps **20** formed in the side wall of the oven in order to regulate the flow of air. A regulating device **21** for the flow of air at the outlet, of a type known per se, is also provided for each fan.

By suitably regulating the admission of steam to the heating elements and the flow of air from each fan, there can, for example, be obtained a temperature of 40° C. in the first heating zone of the bottom conveyor C_n, and a temperature of 45 or 50° C. in the second zone of this same conveyor. In the first zone of the next following conveyor, the temperature can be regulated between 50 and 60° C. and in the second zone between 55 and 70° C.

The temperature of each of the heating zones of the various conveyors can thus be regulated so as to be slightly higher than the temperature of the second zone of the preceding conveyor. Low temperatures of the order of 40° C. can in this way be maintained at different points of the oven, while high temperatures of the order of 150° C. can be simultaneously maintained at other points, depending on the degree of dehydration reached at these points in the product which is being treated.

What I claim is:

1. An oven particularly for dehydrating substances of vegetable origin, said oven comprising an enclosure, a plurality of endless belt conveyors in the enclosure and including two parallel belts arranged one above the other and at different levels, means for independently driving each conveyor, each conveyor moving in the opposite direction to those adjacent which it is positioned, means for discharging the material to be dehydrated at one end of the uppermost of said conveyors by which the material is in turn discharged at the other end thereof onto the next lower conveyor and continuously so in sequence to the lowermost of the conveyors from which the material is evacuated to the outside of the oven, two successive series of heating elements between the edges of each conveyor, means for regulating independently the temperature of the first of the series of heating elements of each conveyor, and means for regulating independently the temperature of the second of the series of heating elements of each conveyor whereby each conveyor comprises two autonomous heating zones adjustable independently of each other and independently of those of the other conveyors.

2. An oven as claimed in claim **1** comprising means for independently regulating the speed of each conveyor.

3. An oven as claimed in claim **1** comprising means for supplying the heating elements of the conveyors other than those of the lowermost conveyor with steam, the first series of heating elements being connected to a first steam circuit and the second series of heating elements being connected

to a second steam circuit, the heating elements of each said series of the lowermost conveyor being connected to the corresponding heating elements of the other conveyors and being supplied with the water of condensation thereof.

4. An oven as claimed in claim 3 comprising for each heating element of the conveyors other than the lowermost, an autonomous steam expansion device.

5. An oven as claimed in claim 1, wherein the means for driving the said conveyors comprise two chains of the sheave type, the said chains being arranged on either side of the conveyor and being secured thereto, comprising a guide frame including a receiving device for receiving each of said chains, said receiving device having a transverse section of cloverleaf shape, and for driving each said chain a surfaced pulley and motor means driving the same, each of said surfaced pulleys driving each of said chains and being positioned at one end of the conveyor.

6. An oven as claimed in claim 5, wherein each conveyor comprises, secured transversely to the face which does not receive the material to be dehydrated, a plurality of U-shaped elements, and a drum comprising longitudinal

members parallel to the base of said U-shaped elements being positioned between the said surfaced pulleys, said U-shaped elements engaging between said longitudinal members upon passage of said conveyor between said pulley, and the legs of said U-shaped elements engaging in the grooves of said pulleys.

7. An oven as claimed in claim 6, wherein the chain includes alternating horizontal and vertical links and the means for driving the conveyors include horizontal lugs on the horizontal links and connected to the associated conveyor.

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