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(54) **Vacuum dryer device**

(57) Vacuum dryer device (10) comprising at least a heatable work surface (12), on which the product to be dried is suitable to be arranged, and cover means which can be coupled with said work surface (12) so as to define an air-tight chamber inside which a depression is created, a condensation apparatus being included comprising at least a bundle of tubes (27) wherein cooling fluid circulates, cooperating with each work surface (12), said bundle of tubes (27) comprising inlet collectors (28a) and outlet collectors (28b) connected to each other by respective conduits (29), said bundle of tubes (27) having a substantially rectilinear longitudinal development extending substantially for the entire length of the relative work surface (12), said inlet collector (28a) and said outlet collector (28b) being arranged axially aligned with each other in correspondence with two opposite sides (12d) of the relative work surface (12).

Fig. 3

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Description

FIELD OF THE INVENTION

[0001] This invention concerns a vacuum dryer device as set forth in the main claim.

[0002] The invention is used to eliminate water, liquids or humidity from products of different nature, and particularly to dry skins which have undergone industrial processing such as, for example, dyeing.

BACKGROUND OF THE INVENTION

[0003] The state of the art includes various devices used to dry skins; among these, those of the vacuum dryer type are greatly appreciated by businessmen working in this field due to the rapidity of the work cycle and because they preserve the peculiarities of the skin treated.

[0004] The functioning of said vacuum dryer devices is based on the fact that the skin is simultaneously heated and subjected to depression, so as to facilitate and accelerate the removal of liquids in the form of steam which is then condensed and discharged.

[0005] Conventional vacuum dryer devices include at least one work surface equipped with heating means and a cover, and can have one or more superimposed work surfaces.

[0006] The skin to be dried is laid on the heated work surface and then pressed by the cover or by the overlying work surface which, as it closes, forms an air-tight chamber inside which the vacuum is created by means of a pump.

[0007] The cover cooperates with mesh-type filter means to allow the passage and discharge, in the form of steam, of the liquids removed.

[0008] The steam removed is made to pass through a condensation apparatus with bundles of tubes inside which a cooling fluid (normally cold water) circulates and cools the steam, making it condense. The bundles of tubes comprise a delivery collector and a return collector inside which the cooling fluid is respectively introduced into and discharged from the bundle of tubes.

[0009] In conventional dryer devices, the delivery and return collectors are arranged on the same side of the work surfaces.

[0010] For this reason, each bundle of tubes comprises a plurality of delivery conduits which cross the work surface in one direction, and a plurality of return conduits which cross the work surface in the opposite direction.

[0011] This travel of the cooling fluid causes a plurality of disadvantages concerning mainly the considerable load losses which occur inside the bundle of tubes due to the inversion of flow of the cooling fluid.

[0012] This entails a reduction in the delivery and therefore of the speed at which the cooling liquid circulates, with a reduced capacity to remove heat and therefore a reduction in performance of the condensation apparatus.

[0013] In its return travel, moreover, the cooling fluid has already acquired heat from the steam which has to be condensed, and therefore flows through the bundle of tubes in the opposite direction at a temperature greater by a few degrees than the temperature at which it was introduced. This entails a reduced yield in terms of heat exchange.

[0014] Moreover, the curve where the flow is inverted, together with the low speed, causes a huge deposit of calcium which has to be periodically removed;

[0015] The present Applicant has devised and embodied this invention to overcome these shortcomings and to obtain further advantages.

SUMMARY OF THE INVENTION

[0016] The invention is set forth and characterized in the main claim, while the dependent claims describe other characteristics of the invention.

[0017] The purpose of the invention is to achieve a vacuum dryer device with a condensation apparatus which, with the cooling fluid having the same characteristics and temperature, has a high yield in terms of heat exchange.

[0018] The vacuum dryer device according to the invention has a substantially conventional structure equipped with one or more heatable work surfaces; these can be coupled at the upper part with cover means which form an air-tight chamber inside which a depression is created suitable to remove the liquids present in the product to be dried.

[0019] The dryer device has a substantially conventional condensation apparatus comprising at least a bundle of tubes for each work surface, fed with cooling fluid.

[0020] Each bundle of tubes comprises an inlet collector through which the cooling fluid is put into circulation by means of feed systems of a conventional type, and an outlet collector through which the cooling fluid is discharged from the bundle of tubes after heat exchange with the steam to be condensed.

[0021] According to the invention, each bundle of tubes has a substantially rectilinear longitudinal development and comprises an inlet collector and an outlet collector arranged in correspondence with two opposite sides of the relative work surface.

[0022] This configuration of the bundle of tubes, with no curves and inversions in direction, considerably limits the load losses of the cooling fluid, allowing to achieve higher circulation speeds and therefore a greater delivery to obtain a greater yield in terms of heat exchange.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] These and other characteristics of the invention will be clear from the description of a preferential form of embodiment, given as a non-restrictive example,

with reference to the attached drawings wherein:

Fig. 1 shows a vacuum dryer device of the type with superimposed work surfaces;
Fig. 2 is a plane view of the work surface of a conventional vacuum dryer device;
Fig. 3 is a plane view of the work surface of a vacuum dryer device according to the invention;
Fig. 4 shows a bundle of tubes of the condensation apparatus of the work surface as in Fig. 2;
Fig. 5 shows a bundle of tubes of the condensation apparatus of the work surface as in Fig. 3.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0024] The vacuum dryer device 10 shown in Fig. 1 comprises a base 11 on which a plurality of work surfaces 12 are suitable to rest one on top of the other so as to be able to close.

[0025] To be more exact, the work surfaces 12 are associated, by means of respective lateral pins 13, with two uprights 14; the work surfaces 12 are vertically movable with respect to the uprights 14, in this case by means of hydraulic movement means 15.

[0026] The upper part 12a of the work surfaces 12, except for the cover 112 of the highest surface, is heated by means of conventional systems.

[0027] In this case, the system to heat the work surfaces 12 provides to use a fluid, for example water or steam, which after having been heated by heating means 16 is introduced into a circuit inside the work surfaces 12 by means of an inlet pipe 17a, and leaves the circuit by means of a mating outlet pipe 17b.

[0028] Each work surface 12, except for the lowest work surface 212, comprises a lower part 12b equipped with a frame 18 which supports a covering sheet (not visible here), for example made of PVC, and with mesh-type filter means 19 at the lower part.

[0029] In the superimposed, closed position of the work surfaces 12, the lower part 12b of one work surface 12 defines, with the upper part 12a of the underlying work surface 12, an air-tight chamber inside which the product to be dried is put and in which a depression is created.

[0030] In this case, the depression is created by means of a pump 20 which, by means of a tube 30, sucks out the air inside the air-tight chamber through rows of holes 21 made in correspondence with the long sides 12c of the work surfaces 12. The steam removed from the products to be dried is sucked out through the same holes 21 and condensed, before it is discharged, by means of a condensation apparatus with bundles of tubes inside which cooling fluid (for example, cold water) circulates.

[0031] Once the drying operation is complete, air at atmospheric pressure is introduced into the chamber through a pipe 23.

[0032] The condensation apparatus of the device 10 comprises, for every work surface 12, a pair of bundles of tubes, each arranged in correspondence with the holes 21 and extending for the entire length of the relative work surface 12.

[0033] Fig. 2 shows a work surface of conventional dryer devices, with bundles of tubes 22 of the type shown in Fig. 4. This bundle of tubes 22 is associated at one end with two collectors, an inlet collector 24a and an outlet collector 24b.

[0034] The cooling fluid is fed by the inlet collector 24a and made to circulate inside a plurality of delivery conduits 25a connected thereto, in this case four, travelling along the entire length of the bundle of tubes 22.

[0035] At outlet from the delivery conduits 25a, the bundle of tubes 22 has an exchange compartment 26 inside which the cooling fluid passes and inverts its direction of travel to flow into four return conduits 25b, arranged adjacent and parallel to said delivery conduits 25a; the fluid is subsequently discharged through the outlet collector 24b. Due to this inversion in correspondence with the exchange compartment 26, the cooling fluid is subject to considerable load losses which limit its speed of circulation.

[0036] This entails both a reduction in the delivery of the fluid, with a diminished yield of the condensation apparatus, and also an increase in the calcium deposits.

[0037] The yield is further diminished due to the fact that the cooling fluid, as it travels through the return conduits 25b, passes at a temperature which is higher by some degrees than its temperature at inlet to the bundle of tubes 22, as it has already carried out a heat exchange with the steam to be condensed passing through the delivery conduits 25a.

[0038] Fig. 3 shows a work surface 12 used in the vacuum dryer device 10 according to the invention, including bundles of tubes 27 of the type shown in Fig. 5. Each bundle of tubes 27 comprises an inlet collector 28a and an outlet collector 28b arranged axially aligned with each other, each in correspondence with a short side 12d of the work surface 12.

[0039] The cooling fluid is fed through the inlet collector 28a and passes inside a plurality of conduits 29, in this case eight, associated at the ends with the outlet collector 28b through which the cooling fluid is discharged. The rectilinear travel of the cooling fluid from the inlet collector 28a to the outlet collector 28b, without passing inside intermediate compartments or channels, and without inverting its direction, considerably limits the load losses, allowing to achieve higher circulation speeds and hence to obtain a greater delivery.

[0040] In this way, therefore, given the same section and number of conduits, there is a better re-circulation of the cooling fluid inside the bundle of tubes 27, with a consequent increase in performance of the condensation apparatus.

[0041] The univocal direction of flow of the cooling fluid as it passes through the bundle of tubes 27 also de-

termines a single heat exchange of the cooling fluid with the steam in conditions of substantially identical temperature, on average lower for all the conduits 29.

[0042] This entails a uniformity of the condensation process throughout the whole bundle of tubes 27 and an increase in performance in the apparatus in general.

[0043] It is obvious, however, that modifications and additions may be made to this invention, but these shall remain within the field and scope thereof.

[0044] For example, the number and section of the conduits 29 of the bundle of tubes 27 may vary according to the type and/or temperature of the cooling fluid used, or again, according to other operating parameters. Also the number and disposition of the bundles of tubes 27 for each work surface 12 may vary, for example according to the configuration and size of the latter.

Claims

1. Vacuum dryer device (10) comprising at least a heatable work surface (12), on which the product to be dried is suitable to be arranged, and cover means which can be coupled with said work surface (12) so as to define an air-tight chamber inside which a depression is created, a condensation apparatus being included comprising at least a bundle of tubes (27) wherein cooling fluid circulates, cooperating with each work surface (12), said bundle of tubes (27) comprising inlet collectors (28a) and outlet collectors (28b) connected to each other by respective conduits (29), the device being characterized in that said bundle of tubes (27) has a substantially rectilinear longitudinal development extending substantially for the entire length of the relative work surface (12), and in that said inlet collector (28a) and said outlet collector (28b) are arranged axially aligned with each other in correspondence with two opposite sides (12d) of the relative work surface (12).

2. Device as in Claim 1, characterized in that the conduits (29) of said bundle of tubes (27) define a univocal direction of flow of the cooling fluid from said inlet collector (28a) to said outlet collector (28b).

3. Device as in Claim 1, characterized in that said condensation apparatus comprises, for every work surface (12), at least a pair of said bundles of tubes (27) developing in correspondence with opposite sides of said work surface (12).

Fig. 1

Fig. 2 (PRIOR ART)

Fig. 3

Fig. 4
(PRIOR ART)

Fig. 5