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(54) WASHING STATION FOR A PAINTING PLANT AND PAINTING PLANT

(57) The washing station (1) for a painting plant (20) comprises a treatment chamber (3) equipped with transport means (26) adapted to transport the products to be treated.

The washing station (1) also comprises supply means (8) for circulating a washing liquid (LV), one or more dispensing nozzles (7) for spraying, nebulizing said washing liquid (LV) in the treatment chamber (3).

Heating means (11) are present that are constituted by a burner (16), a combustion chamber (17) where high-temperature combustion products are generated which are adapted to form a carrier fluid (FV), a heat exchanger (21) with direct exchange, a radiating duct (12) having an evacuation section (14), through which the carrier fluid (FV) exits within the treatment chamber (3) in order to transfer, by means of irradiation and convection, the heat of the carrier fluid (FV) to the same nebulized washing liquid (LV), heating it.

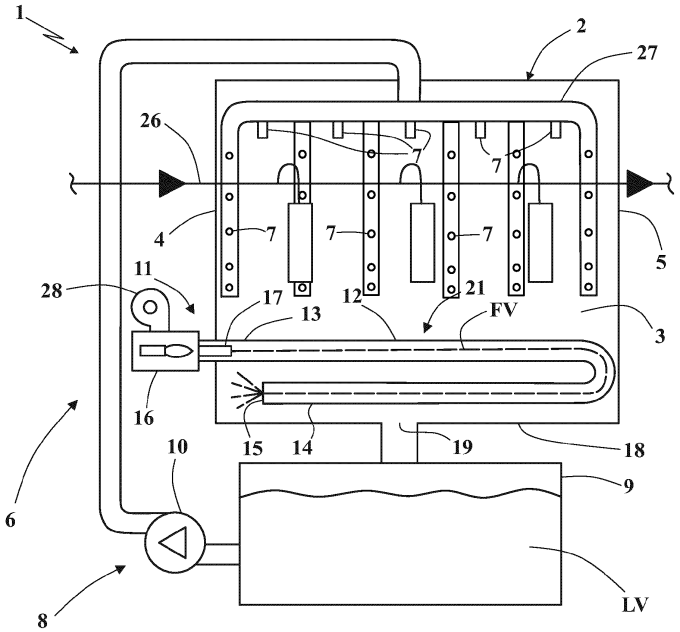

Fig. 1

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Description

Field of application

[0001] The present invention regards a washing station for a painting plant and a painting plant comprising the aforesaid washing station, according to the preamble of the relative independent claims.

[0002] The present washing station is intended to be employed in a painting plant in order to subject a product to a cleaning treatment, in particular degreasing and phosphatizing, before the deposition of a layer of paint on the surface of the product itself.

State of the art

[0003] Known on the market are washing stations for painting plants which are employed for subj ecting a product to be painted to cleaning, degreasing and, in the event that the product is made of metallic material, phosphatizing, so as to remove dirt particles and possibly chemically alter the surface of the product, rendering it suitable for retaining a subsequent layer of paint. A layer of paint deposited on a non-treated product could in fact be detached from the latter at the dirt particles or not optimally adhere, hence leaving portions of product uncovered and defects easily visible by a user, even visible to the naked eye. One example of painting plant provided with washing station is described in DE 804152 and comprises a tunnel structure traversed by transport means for the products to be treated, and it is provided, in sequence, with a first phosphatizing station, with a washing station having nozzles directed towards the transport means in order to wet the products transported thereby with a washing liquid, with a rinsing station, with a second phosphatizing station and with a drying station.

[0004] The washing stations of known type conventionally comprise a containment structure extended between an inlet section and an outlet section, which is intended to be traversed by known transport means, such as for example an aerial chain conveyor or a belt conveyor, for conveying products to be treated from the inlet section to the outlet section. The washing station comprises multiple dispensing nozzles configured for spraying a washing liquid towards the transport means in a manner such that the products to be treated are wet by the washing liquid itself during their advancement in the containment structure. The dispensing nozzles are placed in fluid communication with a storage tank for containing the washing liquid and they are supplied by pumping means, which draw the aforesaid liquid from the tank and deliver it to the dispensing nozzles.

[0005] In order to optimally execute the cleaning, the degreasing and possibly the phosphatizing of the product, the washing liquid must be heated to an operating temperature of about 75° C. The storage tank, therefore, is internally traversed by a heat exchanger, for example a coil, which is externally hit by the washing liquid and is supplied with a hot carrier fluid in order to heat the aforesaid liquid. Such carrier fluid can alternatively be an aqueous solution heated by a boiler or high-temperature combustion gases generated by a burner.

[0006] One example of a washing station is known from the contents of the United States patent US 6,131,525. Such washing station is employed for degreasing and removing motor oil from metallic recovery components before these are treated and recycled, and it is provided with a storage tank and with a heating duct traversed by a hot carrier fluid, as described above. The heating duct is provided, in particular, with an initial portion immersed in the washing liquid collected in the tank, in order to heat it, and a final stack which is extended outside the containment structure and which releases the hot carrier fluid directly into the outside environment.

[0007] Further examples of washing stations of known type are reported in the patents GB 932,490 and US 4,323,091, which provide for a heating duct provided with an initial section immersed in the washing liquid, and with a final portion which is extended outside the containment structure and which terminates with an expulsion mouth in communication with the interior of the containment structure in order to introduce the hot carrier fluid therein.

[0008] The washing stations briefly described up to now have in practice shown that they do not lack drawbacks.

[0009] The main drawback lies in the fact that the heat exchanger is subj ected to encrustation over time, i.e. to the deposit of limescale and possibly phosphates contained in solution in the washing liquid on its exchange surfaces. The encrustation particularly occurs during the periods of inactivity of the washing station and involves a reduction of the thermal exchange between the heat exchanger itself and the washing liquid contained in the storage tank. In order to obviate such thermal exchange reduction, it is necessary to increase the temperature of the fluid which traverses the heat exchanger, therefore increasing the energy consumptions.

[0010] In addition, in order to restore the correct thermal exchange between the heat exchanger and the washing liquid, maintenance operations with long machine stoppage times are required, which provide for the removal of the heat exchanger from the storage tank and a cleaning of its exchange surfaces in order to remove the encrustation.

[0011] A further drawback of the washing stations of known type lies in the fact that the thermal inertia of the washing liquid contained in the tank is high. Therefore, following a machine stoppage in which the temperature of the liquid has fallen to nearly ambient temperature, it is necessary to carry out a long phase for starting the washing station in order to ensure that the heat exchanger brings the washing liquid to the operating temperature.

[0012] A further drawback of the washing stations of known type lies in the high investment costs for attaining the washing station, in particular linked to the heat exchanger.

Presentation of the invention

[0013] Therefore, in such context, the main object of the present invention is to overcome the drawbacks of the above-described prior art, by providing a washing station and a painting plant which have reduced energy consumptions.

[0014] Further object of the present invention is to provide a washing station and a painting plant which does not have significant drawbacks due to encrustations of their components. Further object of the present invention is to present a washing station and a painting plant which require limited maintenance operations.

[0015] Further object of the present invention is to provide a washing station and a painting plant capable of quickly returning to operation at normal conditions after machine stoppage, in particular having a limited thermal inertia for the heating.

[0016] Further object of the present invention is to provide a washing station and a painting plant which are inexpensive and entirely functional in operation.

Brief description of the drawings

[0017] The technical characteristics of the invention, according to the proposed task and objects, are clearly seen in the contents of the below-reported claims and the advantages thereof will be more evident in the detailed description of several embodiments, according to the invention, illustrated by way of a non-limiting example in the enclosed drawing tables in which:

- figure 1 illustrates a side schematic view of a washing station for a painting plant, object of the present invention;
- figure 2 illustrates a side schematic view of a painting plant, object of the present invention, which comprises the washing station illustrated in figure 1.

Detailed description of a preferred embodiment

[0018] With reference to the enclosed drawings, reference number 1 overall indicates a washing station for a painting plant according to the present invention.

[0019] The present washing station 1 is intended to be employed in a painting plant in order to subject a product to a cleaning treatment, in particular degreasing and phosphatizing, before the deposition of a layer of paint on the surface of the product itself. Other types of cleaning treatment and preparation for painting of the product can still be activated herein, both simultaneously with the abovementioned treatments in the same station, and separately, in other adjacent stations that are situated in series, upstream or downstream of the aforesaid station.

[0020] The washing station 1 for a painting plant comprises at least one hollow containment structure 2, usually constituted by a load-bearing metallic frame, to which surfaces of sandwich panel type (sheet-insulation-sheet) are fixed, which have the functions of delimiting a clear specific volume and of supporting all the components necessary for the predetermined object.

[0021] Advantageously the hollow containment structure 2 has closed parallelepiped form on 4 sides and in such a manner internally delimits a treatment chamber 3 which is extended between an inlet section 4 (first open lateral side of the parallelepiped of the hollow containment structure 2) and an outlet section 5 (second open vertical side of the parallelepiped of the hollow containment structure 2), the latter outlet section 5 being opposite the inlet section 4.

[0022] Suitably, the containment structure 2 is intended to be traversed by transport means 26, which advantageously comprise a catenary line, to which the products to be treated are suitable fixed, or better yet coupled, such products thus traversing the treatment chamber 3 which a path that extends from the inlet section 4 to the outlet section 5 of the so-called treatment chamber 3.

[0023] The washing station 1 comprises a hydraulic plant 6 operatively connected to the containment structure 2, which is provided with supply means 8 advantageously comprising a storage tank 9 underlying the treatment chamber 3, which is provided on its bottom wall 18 with an outlet opening 19 communicating with the storage tank 9 itself and through such opening the washing liquid LV flows via free fall, being collected in the underlying storage tank 9. Preferably, the supply means 8 also comprise a pumping system 10 (pump and pipes) adapted to transport the washing liquid LV from the storage tank 9 within multiple supply pipes 27, the latter positioned within the treatment chamber 3 and which are in turn connected at the final part to the dispensing nozzles 7 which suitably and efficiently spray the washing liquid LV within the treatment chamber 3, where the product to be wet for the purpose of the cleaning treatment is situated to slide, suspended on the catenary.

[0024] Still according to the present invention, the washing station 1 is characterized in that it incorporates heating means 11 comprising a burner 16, which is connected to a combustion chamber 17 susceptible of generating high-temperature combustion products at the interior thereof, which are in turn adapted to form, at least partly, a carrier fluid FV; advantageously, the heating means 11 comprise a heat exchanger 21 with direct exchange (the combustion products are released into the environment, in this case into the treatment chamber 3) which is partially housed within the treatment chamber 3 constituting part of the containment structure 2.

[0025] The heat exchanger 21 comprises a radiating duct 12, which is provided with a supply section 13 directly connected to the combustion chamber 17 of the burner 16 so as to be able to introduce the carrier fluid FV (mainly high-temperature combustion products) into such radiating duct 12; advantageously, such radiating duct 12 is also provided with an evacuation section 14, through which the carrier fluid FV is susceptible of exiting in order to be directly introduced into the treatment cham-

ber 3 and be mixed in the same with the washing liquid LV nebulized by the dispensing nozzles 7 and coming, by means of the pumping system 10 (pump and pipes) from the storage tank 9 in order to subsequently pass through the supply pipes 27, to which the dispensing nozzles 7 of the washing liquid LV are connected.

[0026] Advantageously the radiating duct 12 is in part housed within the treatment chamber 3 in order to be able to transfer to the same, mainly by means of a thermal exchange via irradiation and the rest via convection, a part of the heat of the carrier fluid FV which circulates at high temperature within the radiating duct 12 itself.

[0027] Advantageously, the radiating duct 12 of the heat exchanger 21 is placed at least partially to traverse the treatment chamber 3. In particular, the radiating duct 12 is extended completely within the treatment chamber 3.

[0028] Preferably, the radiating duct 12 is extended in the treatment chamber 3, being extended projectingly towards the interior of the latter with respect to the containment structure 2. Advantageously, the containment structure 2 has a substantially tunnel-like shape and is extended between the inlet section 4 and the outlet section 5 with four closed sides which delimit the treatment chamber 3 between them.

[0029] Advantageously, the radiating duct 12 is extended within the containment structure 2 in a position spaced from the aforesaid close sides, so as to maximize its contact surface with the internal volume of the treatment chamber 3, in particular maximizing the thermal irradiation within the latter.

[0030] Preferably, the radiating duct 12 is placed outside the storage tank 9 of the washing liquid LV, so as to prevent the washing liquid LV itself from being encrusted on the radiating duct 12, modifying the thermal exchange characteristics thereof and requiring frequent maintenance operations and machine stoppage times.

[0031] Preferably, the radiating duct 12 is arranged in a manner such that its evacuation section 14 for the carrier fluid FV is in turn provided with a suitable expulsion mouth 15 which, always placed inside the treatment chamber 3, is configured in a manner such to expel the carrier fluid FV into the same, in a manner such that this is mixed with the washing liquid LV nebulized by the dispensing nozzles 7 and transfers, to the latter, part of its sensible heat and part of its latent heat of condensation; in more detail, the hot fumes, i.e. the carrier fluid FV which exits from the expulsion mouth 15 at a temperature of about 250°C encounters the nebulized washing liquid LV, present nebulized in the treatment chamber 3 and which is found at a lower temperature, about 50°C lower, thus generating a thermal exchange that is both sensible and latent (adiabatic).

[0032] Advantageously, the radiating duct 12 is situated positioned between the supply pipes 27, which are connected to the dispensing nozzles 7 of the washing liquid LV, and the bottom wall 18 of the treatment chamber 3; the object is that of making at least part of the washing liquid LV that is sprayed by the dispensing nozzles 7, and which is collected on the bottom of the bottom wall 18 of the treatment chamber 3, intercept and thus be heated by the radiating duct 12; the latter washing liquid LV is then intended to be brought back into the storage tank 9 underlying the treatment chamber 3 by free fall, through suitable outlet opening 19 which is situated on the bottom wall 18 of the treatment chamber 3. In order to optimize at least a part of the washing liquid LV, the radiating duct 12 is placed advantageously at the bottom wall 18 of the treatment chamber 3; in particular the radiating duct 12 is placed internally and on the bottom wall 18 of the treatment chamber 3 in a longitudinal manner, parallel to the path of the catenary that transports the product and extended between the inlet section 4 (first open vertical side of the parallelepiped of the hollow containment structure 2) and the opposite outlet section 5 (second open vertical side of the parallelepiped of the hollow containment structure 2).

[0033] Advantageously the washing station 1 is characterized in that the heating means 11 assembly comprises a supply fan 28 mainly for providing comburent air to the burner 16 operatively connected to the heat exchanger 21, in turn comprising the radiating duct 12, which is provided with a supply section 13 directly connected to the combustion chamber 17 of the burner 16 so as to be able to introduce the carrier fluid FV (mainly high-temperature combustion products generated in the combustion chamber 17) in such radiating duct 12; the supply fan 28 is thus arranged in order to force the carrier fluid FV to first flow into the radiating duct 12 from the supply section 13 to the evacuation section 14, then through the expulsion mouth 15, into the treatment chamber 3.

[0034] Advantageously the burner 16 is placed outside the treatment chamber 3, ensuring a safer and easier supply of the fuel gas, a simplified maintenance and possible operations at any time, without obstructing the process cycle of the painting plant to which the washing station 1 is attached as an integral part.

[0035] Another object of the present invention is a painting plant 20, discussed hereinbelow.

[0036] In accordance with a preferred embodiment of the present invention illustrated in figures 1, 2, the painting plant 20 comprises transport means 26 preferably constituted by a catenary support and movement line adapted to transport the products to be treated between the inlet station S1 and the outlet station S2 of the painting plant 20 itself.

[0037] Suitably, the painting plant comprises a tunnel-shaped structure 20' (per se of conventional type) extended between the inlet station S1 and the outlet station S2, and provided with containment walls which delimit a passage tunnel traversed by the transport means 26. The painting plant 20 comprises a washing station 1 of the above-discussed type, which is traversed by the transport means 26 that support the products to be treated and is arranged in order to be able to wash the products

to be treated with the suitable washing liquid LV, as described in detail above.

[0038] In particular, the support structure 2 of the washing station 1 is integrated in the tunnel-shaped structure 20' of the painting plant 20.

[0039] Preferably, the painting plant 20 comprises a second washing station 29 placed between the washing station 1 and the outlet station S2 of the painting plant 20, which is traversed by the transport means 26 that support the products to be treated and is arranged only to be able to wash the products to be treated with second washing liquid LV2 (usual neutral water).

[0040] Preferably, the painting plant 20 comprises a third washing station 30 placed between the second washing station 29 and the outlet station S2 of the painting plant 20, which is traversed by the transport means 26 that support the products to be treated and is arranged only to be able to wash the products to be treated with a third washing liquid LV3 (usually demineralized water).

[0041] Preferably, the second and third washing station 29, 30 comprise suitable pipes and nozzles connected to respective hydraulic circuits, in a per se conventional manner, in a manner such to dispense the respective washing liquid LV2, LV3 on the products to be treated. Advantageously, the painting plant 20 comprises a drying station with air knife 31 placed between the washing station 1 and the outlet station S2, and in particular placed downstream of the third washing station 30, between the latter and the outlet station S2. Such drying station with air knife 31 is traversed by the transport means 26 and comprises blowing means 32 (for example comprising one or more suitable fans) placed outside the painting plant 20 and configured for introducing, in such drying station 31, an air knife adapted to intercept the transport means 26 in order to remove from the surfaces of the products to be treated at least part of the washing liquid drops (in particular of the third washing liquid LV3) and expel them outside the painting plant 20 by means of at least one evacuation opening 33 of the drying station 31 itself advantageously made on a part of the containment walls of the tunnel-shaped structure 20' of the painting plant 20.

[0042] The blowing means 32 are also configured for suctioning and expelling, in the same manner, both the carrier fluid FV generated in the treatment chamber 3 (emitted by the heating means 11 by means of the heat exchanger 21 with direct exchange in the treatment chamber 3) and an external ambient air flow which enters, suctioned by the inlet station S1 of the painting plant 20 and suctioned towards the drying station with air knife 31. Both the carrier fluid FV and the renewal external ambient air flow that enters suctioned from the inlet station S1 (from where, by means of the transport means 26, also the products to be treated enter), before entering into the drying station with air knife 31 and both being expelled outside through the opening 33 by the blowing means 32, both traverse the washing stations which are situated on the path starting from the washing station 1 towards the drying station with air knife 31.

[0043] Suitably, in particular the carrier fluid FV in the path traversing the various washing stations encounters the various nebulized washing liquids present in the washing stations themselves, and such liquids LV, LV2, LV3, being situated at a temperature lower than that of the carrier fluid FV, in specific cases lead to cooling the carrier fluid FV up to the condensation of the combustion products due to the thermal exchange, both sensible and latent (adiabatic), that occurs between them; the result is an energy savings for the heating of the same washing liquids LV, LV2, LV3 serving the various washing stations present in the painting plant 20.

[0044] The painting plant 20 also comprises a drying station 22 placed, in the case represented in figure 2, between the last drying station with air knife 31 described above and before the outlet station S2 of the painting plant 20; the drying station 22 is traversed by the transport means 26 which support the products to be treated and comprises a heating device 23 configured and suitably sized with regard to thermal power so as to be able to suitably heat the products to be treated in a manner such that there is a correct drying process for the same.

[0045] Advantageously the drying station 22 comprises ventilation means 25 placed outside the drying station 22 itself, arranged and configured for being able to suction and expel outside the exhaust air that comes from the drying of the products to be treated present in the drying station 22.

[0046] The painting plant 20 also comprises a painting station 24 for the products to be treated, which is placed between the drying station 22 and the outlet station S2 and traversed by the transport means 26 which support the products to be treated; in detail, this is also provided with opportune and suitable painting means having the obj ect of depositing, on the products to be treated, a layer of paint or other similar products.

Claims

1. Washing station (1) for a painting plant, said washing station (1) comprising:

   - a hollow containment structure (2), which internally defines a treatment chamber (3) and is extended between an inlet section (4) and an outlet section (5) opposite said inlet section (4); said containment structure (2) being intended to be traversed by transport means (26) adapted to transport products to be treated through said treatment chamber (3) from said inlet section (4) to said outlet section (5);
   - a hydraulic plant (6) operatively connected to said containment structure (2), and comprising:

     - supply means (8) arranged for providing at least one washing liquid (LV);

- one or more dispensing nozzles (7), which are connected to said supply means (8) in order to receive said washing liquid (LV), are placed inside the treatment chamber (3) of said containment structure (2) and are configured for spraying said washing liquid (LV) in said treatment chamber (3) in order to wet said products to be treated;

- heating means (11) comprising at least one burner (16) provided with a combustion chamber (17) susceptible of generating high-temperature combustion products adapted to form, at least partly, a carrier fluid (FV);

said washing station (1) being **characterized in that** it comprises at least one heat exchanger (21) with direct exchange, which is at least partially housed within the treatment chamber (3) of said containment structure (2), and comprises at least one radiating duct (12), which:

- is provided with a supply section (13), which is connected to the combustion chamber (17) of said burner (16) in order to introduce said carrier fluid (FV) in said radiating duct (12), and with an evacuation section (14), through which said carrier fluid (FV) is susceptible of exiting from said radiating duct (12), and
- is housed at least partially within said treatment chamber (3) in order to transfer, at least by means of irradiation, at least part of heat of said carrier fluid (FV) to said treatment chamber (3).

2. Washing station (1) according to claim 1, **characterized in that** the evacuation section (14) of said radiating duct (12) is provided with an expulsion mouth (15) placed inside said treatment chamber (3) and configured for expelling said carrier fluid (FV) in said treatment chamber (3).

3. Washing station (1) according to any one of the preceding claims, **characterized in that** said supply means (8) comprise:

- at least one storage tank (9), which is placed in fluid communication with said dispensing nozzles (7) and is adapted to contain said washing liquid (LV);
- pumping means (10) operatively connected to said dispensing nozzles (7) and to said at least one storage tank (9) and configured for conveying said washing liquid (LV) from said at least one storage tank (9) to said dispensing nozzles (7);

wherein said containment structure (2) comprises a bottom wall (18) provided with at least one outlet opening (19) in fluid communication with said at least one storage tank (9), in order to convey said washing liquid (LV) sprayed by said dispensing nozzles (7) within said at least one storage tank (9).

4. Washing station (1) according to claim 3, **characterized in that** said radiating duct (12) is placed between at least part of said dispensing nozzles (7) and said bottom wall (18), in order to intercept at least part of the washing liquid (LV) sprayed by said dispensing nozzles (7) and intended to be brought back into said at least one storage tank (9) through said at least one outlet opening (19).

5. Washing station (1) according to claim 4, **characterized in that** said radiating duct (12) is placed at said bottom wall (18).

6. Washing station (1) according to any one of the preceding claims, **characterized in that** said hydraulic plant (6) comprises multiple supply pipes (27) which are connected to said dispensing nozzles (7) and are placed within said treatment chamber (3).

7. Washing station (1) according to any one of the preceding claims, **characterized in that** said heating means (11) comprise at least one supply fan (28) operatively connected to said radiating duct (12) and arranged for forcing said carrier fluid (FV) to flow into said radiating duct (12) from said supply section (13) to said evacuation section (14).

8. Washing station (1) according to any one of the preceding claims, **characterized in that** said burner (16) is placed outside said treatment chamber (3).

9. Washing station (1) according to any one of the preceding claims, **characterized in that** the radiating duct (12) of said heat exchanger (21) is placed, at least partially, to traverse said treatment chamber (3).

10. Washing station (1) according to any one of the preceding claims, **characterized in that** said containment structure (2) is closed on at least four sides which are extended from said inlet section (4) to said outlet station (5) and delimit said treatment chamber (3) between them;
wherein the radiating duct (12) of said heat exchanger (21) is extended within said containment structure (2) between said four closed sides of said containment structure (2).

11. Washing station (1) according to claim 10, **characterized in that** said radiating duct (12) is extended within said treatment chamber (3) in a position spaced from the close sides of said containment structure (2).

12. Painting plant (20), which comprises:

- transport means (26) adapted to transport products to be treated between an inlet station (S1) and an outlet station (S2);
- a washing station (1) according to any one of the preceding claims, traversed by said transport means (26), arranged for washing said products to be treated with said washing liquid (LV).
- a drying station (22) placed between said washing station (1) and said outlet station (S2), traversed by said transport means (26) and comprising a heating device (23) configured for heating said products to be treated, drying them;
- a painting station (24) placed between said drying station (22) and said outlet station (S2), traversed by said transport means (26) and provided with painting means in order to deposit a layer of paint on said products to be treated.

13. Painting plant (20) according to claims 12 and 2, **characterized in that** said drying station (22) comprises ventilation means (25) configured for being able to suction at least exhaust air coming from the drying of the products to be treated present in the drying station (22).

14. Painting plant (20) according to claim 12 or 13, **characterized in that** it comprises a drying station with air knife (31) placed between said washing station (1) and said outlet station (S2), traversed by said transport means (26) and comprising blowing means (32) configured for generating at least one air knife adapted to intercept said transport means (26) in order to remove from the surfaces of said products to be treated at least part of the washing liquid drops and expel them outside said painting plant (20) by means of at least one evacuation opening (33) of said drying station with air knife (31); said blowing means (32) also being configured for suctioning at least said carrier fluid (FV) from said treatment chamber (3) and at least one external ambient air flow from said inlet station (S1) of said painting plant (20) towards said drying station with air knife (31) and expel them outside said painting plant (20) by means of said at least one evacuation opening (33).

15. Painting plant (20) according to claim 14, **characterized in that** it comprises:

- a second washing station (29), placed between said washing station (1) and said drying station with air knife (31), traversed by said transport means (26), arranged for washing said products to be treated with a second washing liquid (LV2);
- a third washing station (30), placed between said second washing station (29) and said drying station with air knife (31), traversed by said transport means (26), arranged for washing said products to be treated with a third washing liquid (LV3).

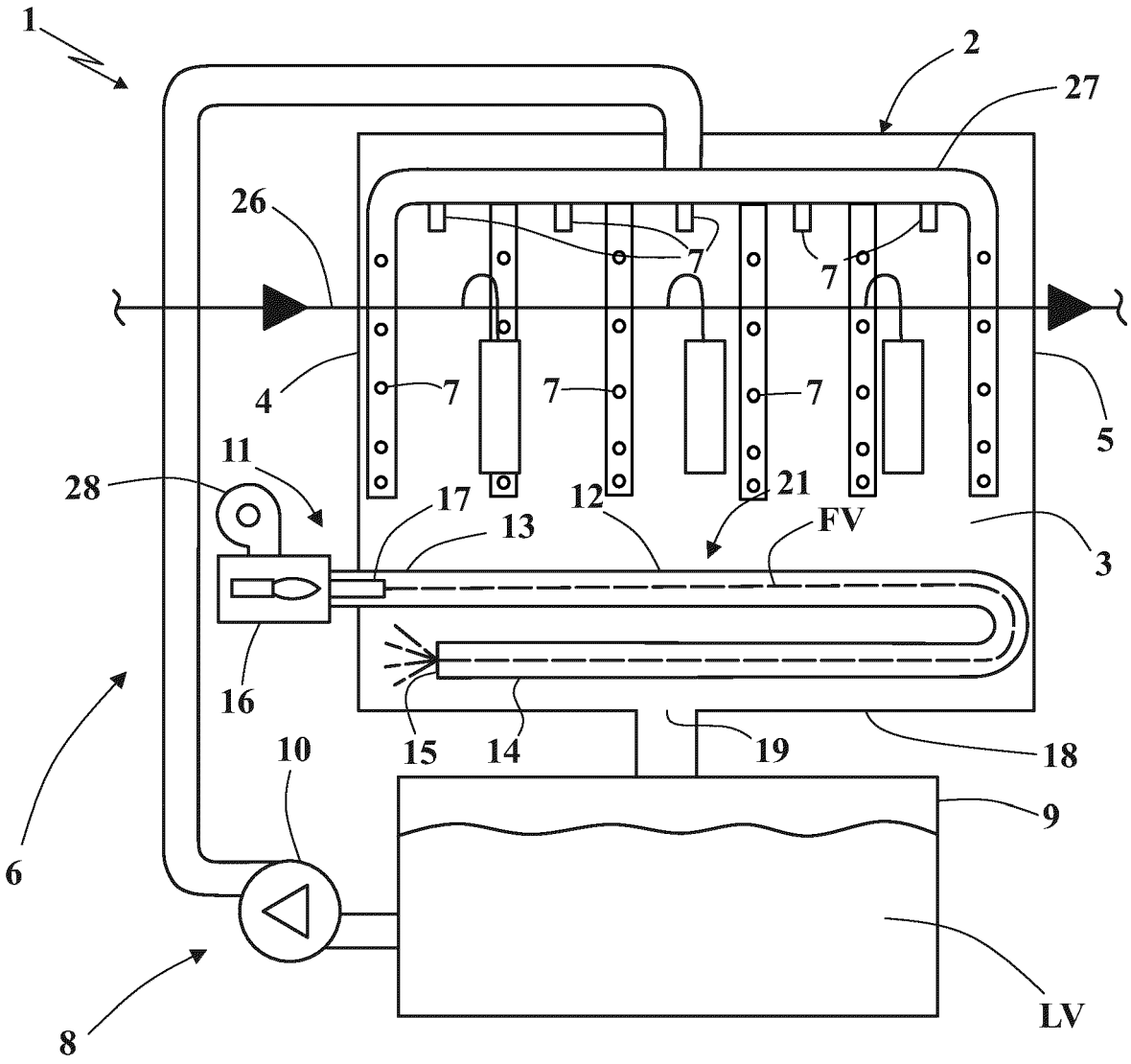
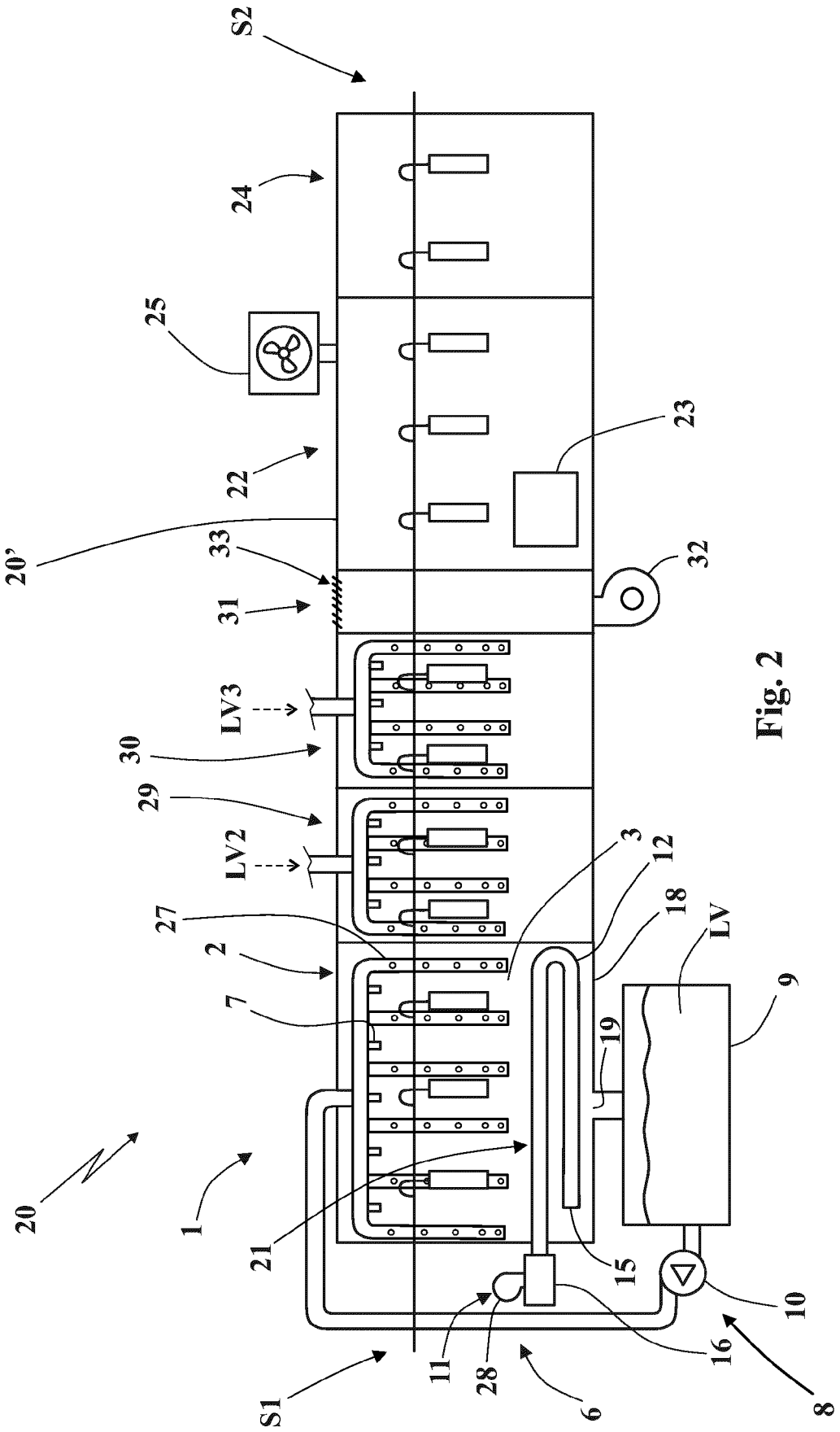


Fig. 1


S2
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LV3
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S1

Fig. 2

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 5792

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	GB 932 490 A (ROBERT KNABE NOLTE) 31 July 1963 (1963-07-31) * the whole document *	1-11 12-15	INV. B08B3/02
Y A	DE 804 152 C (BENNO SCHILDE MASCHINENBAU - AKT.-GES.) 16 April 1951 (1951-04-16) * the whole document *	12-15 1,3,6	
X A	US 4 323 091 A (NOLTE ROBERT K ET AL) 6 April 1982 (1982-04-06) * abstract * * column 1, line 6 - line 12 * * column 1, line 60 - line 68 * * column 2, line 14 - column 4, line 7 * * column 4, line 56 - line 65 * * column 5, line 28 - column 6, line 2 * * claims * * figures *	1-11 12-15	
X A	US 6 131 525 A (MYERS JOHN E [US]) 17 October 2000 (2000-10-17) * abstract * * column 1, line 5 - line 6 * * column 1, line 28 - line 59 * * column 2, line 57 - line 64 * * column 4, line 7 - line 28 * * claims * * figures *	1-11 12	TECHNICAL FIELDS SEARCHED (IPC) B08B F26B
A	EP 1 146 999 B1 (BPB PLC [GB]) 1 October 2003 (2003-10-01) * paragraph [0007] * * paragraph [0013] * * claims * * figures *	1,3,6, 12-15	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 August 2021	van der Zee, Willem

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 5792

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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