

(22) Date of filing: **01.09.2023**

(71) Applicant: **IDM S.r.l.**
80139 Napoli (IT)

(72) Inventor: **VIOLA, Salvatore**
I-80139 NAPOLI (IT)

(74) Representative: **Pulieri, Gianluca Antonio**
Jacobacci & Partners S.p.A.
Piazza della Vittoria, 11
25122 Brescia (IT)

(30) Priority: 16.09.2022 IT 202200019026

in the hopper to separate flakes from cloudy water. The machine further comprises a clarification unit (11) to subject the cloudy water to a clarification process so that it may be reused for cleaning tools. [Fig. 1]



Description

Field of the invention

[0001] The present invention relates to a machine for cleaning tools used during manual painting operations, such as spray guns, roller dye guns or dye pens used in the leather dyeing industry. Innovatively, as will be discussed below, the machine according to the present invention also performs a treatment of the cleaning water in order to separate the sludge to be sent for disposal from the liquid part; this is clarified and reused for subsequent cleaning cycles, in a closed circuit.

[0002] The same machine may also be used in sectors other than leather processing, such as vehicle bodywork painting, suitably by modifying the process parameters, treatment cycles and additives required for treating the cleaning water.

Prior art

[0003] Numerous devices are known for cleaning painting tools. Generally, such devices are placed near or within the environments where painting takes place. The cleaning water they produce, generally an opaque and turbid mixture, needs to be transported to a treatment site, where it undergoes solid sludge extraction processes. The cleaning water has a much larger volume than solid sludge; therefore, transportation is complicated and costly.

[0004] Another example is shown in US-A1-2019/291147, which illustrates a cleaning device for painting tools; however, such a device lacks a boiler and is therefore unable to obtain compacted sludge by a process of heating the flakes obtained from the flocculation of the cleaning water in a boiler.

[0005] The object of the present invention is to make a machine that is able to meet the needs of the industry and overcome the drawbacks mentioned above, particularly by making the cleaning process environmentally sustainable.

[0006] This object is achieved by a machine according to claim 1. The dependent claims disclose further advantageous embodiments of the invention.

Brief description of the drawings

[0007] The features and advantages of the machine according to this invention will become apparent from the following description, given by way of non-limiting example according to the figures in the accompanying drawings, wherein:

- Fig. 1 shows a machine according to a preferred embodiment of the present invention, according to a front view;
- Fig. 2 represents the machine in Fig. 1, according to a rear view;

- Fig. 3 illustrates a schematic view of the machine from Fig. 1 and 2.

Description of a preferred embodiment of the invention

[0008] With reference to the figures in the appended drawings, a machine according to a preferred embodiment of the present invention is collectively indicated by 100. The machine 100 is suitable for manually and/or automatically cleaning tools used in painting operations, such as spray guns, roller dye guns, or dye pens, and for treating cleaning water resulting from cleaning the tools.

Machine structure

[0009] The machine 100 comprises a supporting structure, for example composed of a frame formed by a plurality of joists joined together; for example, said joists are made of plastics material, such as isotactic polypropylene.

[0010] The machine 100 comprises a first tank 1, a second tank 2, a third tank 3, a fourth tank 4, a hopper 5, a flocculant reservoir 6a, a chlorine tank 6b, a boiler 7, a sludge collection drawer 8, a sink 9 with a tap 9a, an actuator 9b for the tap 9a, preferably foot-operated, a cleaning device 10 and a clarification unit 11, comprising a plurality of filters 11'. For example, the clarification unit 11 comprises quartzite filters 11a and activated carbon filters 11b, preferably in the form of cylinders.

[0011] The machine 100 further comprises electronic management means 13, configured or programmed to manage cleaning and treatment operations, comprising, for example, a PLC or a microchip or a dedicated circuit board, display means 14 for displaying operating statuses of the machine, comprising for example a display, and control means 15 for imparting commands to the machine, comprising for example a keyboard, mouse, or touchscreen.

[0012] Preferably, the control means 15 in the form of touchscreens are integrated with the display means 14. The management means 13 are operatively connected to the display means 14 and the control means 15; the control means 15 are operatively connected to the display means 14.

[0013] The first tank 1 is intended to contain purified water and water to be purified and is operatively connected to a first maximum level sensor S1a for detecting the maximum water level in the first tank 1.

[0014] Furthermore, the first tank 1 is fluidically connected to the clarification unit 11 and operatively connected to a first pump P1 for feeding the water contained in the first tank 1 to the clarification unit 11.

[0015] Furthermore, the first tank 1 is fluidically connected to the chlorine tank 6b, from which it is supplied with a predetermined amount of chlorine; the supply of chlorine from the chlorine tank 6b to the first tank 1 is regulated by a second dosing pump VD2.

[0016] Furthermore, the first tank 1 is fluidically connected to the second tank 2 and operatively connected to a second pump P2 for feeding the water contained in the first tank 1 to the second tank 2.

[0017] The second tank 2 is intended to contain purified water to be used for cleaning tools and is operatively connected to a second maximum level sensor S2a for detecting the maximum water level in the second tank 2. Furthermore, the second tank 2 is operatively engaged with a first electrical resistor R1 for heating the water contained in the second tank 2.

[0018] Furthermore, the second tank 2 is fluidically connected to the tap 9a of the sink 9, operable by the actuator 9b, and to the cleaning device 10 and is operatively connected to a third pump P3 for feeding the water contained in the second tank 2 to either the tap 9a or the cleaning device 10. The water flow from the second tank 2 to the tap 9a or to the cleaning device 10 is regulated by a first solenoid valve EL1, located upstream of the cleaning device 10, and a second solenoid valve EL2, located upstream of the tap 9a.

[0019] The sink 9 and the cleaning device 10 are fluidically connected to the third tank 3, into which they transfer the cleaning water.

[0020] The third tank 3 is intended to contain the cleaning water used for cleaning tools and is operatively connected to a third maximum level sensor S3a for detecting the maximum water level in the third tank 3.

[0021] Furthermore, the third tank 3 is fluidically connected to the hopper 5 and operatively connected to a fourth pump P4 for feeding the water contained in the third tank 3 to the hopper 5.

[0022] The hopper 5 is intended to contain the cleaning water to be subjected to flocculation; for this purpose, it cooperates with a mechanical stirrer 12 to facilitate stirring and is operatively connected to the flocculant reservoir 6a, from which it is supplied with a predetermined amount of flocculant agents. The supply of flocculant agents from the flocculant reservoir 6a to the hopper 5 is regulated by a first dosing pump VD1.

[0023] The first dosing pump VD1 and the second dosing pump VD2 are operatively connected to the management means 13 and actuated thereby.

[0024] The hopper 5 is operatively connected to a fifth maximum level sensor S5a for detecting the maximum water level in the hopper 5.

[0025] The hopper 5 is fluidically connected to the first tank 1 to transfer therein the cloudy water formed during flocculation. The flow of water from the hopper 5 to the first tank 1 is regulated by a third solenoid valve EL3, which is preferably motorized.

[0026] Furthermore, the hopper 5 is fluidically connected to the boiler 7 to transfer therein the flakes obtained from the flocculation. The flow of flakes from the hopper 5 to the boiler 7 is regulated by a fourth solenoid valve EL4, which is preferably motorized.

[0027] The boiler 7 is also fluidically connected to the fourth tank 4 for the collection of the residual water trans-

ferred from the boiler 7. The flow of residual water from the boiler 7 to the fourth tank 4 is regulated by a fifth solenoid valve EL5, preferably motorized, and a sixth solenoid valve EL6, preferably motorized, which, operated at the same time as the fifth solenoid valve EL5, allows air to enter the boiler 7 and promotes the discharge thereof.

[0028] The fourth tank 4 is intended to contain the residual water transferred from the boiler 7 and is operatively connected to a fourth maximum level sensor S4a for detecting the maximum water level in the fourth tank 4.

[0029] The fourth tank 4 is fluidically connected to the first tank 1 and operatively connected to a fifth pump P5 for feeding the water contained in the fourth tank 4 to the first tank 1.

[0030] Said level sensors S1a, S2a, S3a, S4a, S5a monitor the maximum level and are operatively connected to the management means 13 for transmitting respective maximum level signals to said management means 13. Preferably, there are also minimum level sensors S1b, S2b, S3b, S4b, S5b that monitor the minimum water level and are operatively connected to the management means 13 for transmitting respective minimum level signals to said management means 13 in order to ensure the correct operating cycle and to prevent abnormal conditions that may result in pump failure.

[0031] Said pumps P1, P2, P3, P4, P5 are operatively connected to the management means 13 and/or the control means 14 to be started or stopped. Said solenoid valves EL1, EL2, EL3, EL4, EL5, EL6 and said dosing pumps VD1, VD2 are operatively connected to the management means 13 and/or the control means 14 to be actuated. Said resistor R1 is operatively connected to the management means 13 to be activated.

[0032] Preferably, moreover, there are a seventh solenoid valve EL7, located on the filter 11a, and an eighth solenoid valve EL8, located on the filter 11b, operatively connected to the first pump P1 and the management means 13 and/or the control means 14 to be actuated.

Turning on the machine

[0033] When the machine 100 is first turned on, it is necessary to fill the first tank 1 to the maximum level and the second tank 2 to the maximum level with clean water; the third tank 3 and the fourth tank 4 should be filled with water to the minimum level.

[0034] With the actuation of the first resistor R1 by the management means 13, moreover, the water temperature of the second tank 2 is maintained at a desired preset value, such as 30°C.

[0035] Furthermore, for the machine 100 to be operational, the flocculant reservoir 6a is provided with flocculant agents and the chlorine tank 6b with chlorine.

Tool cleaning cycle

[0036] A tool cleaning cycle is executable through the

machine 100 according to two cleaning modes:

1) According to a first cleaning mode, or manual cleaning mode, the machine 100 allows for the manual cleaning of painting tools. For this purpose, by starting the drive 9b (which causes the first solenoid valve EL1 to open and the third pump P3 to start), water from the second tank 2 is fed to the tap 9a of the sink 9; the operator may then clean the tools. The cleaning water is collected in the third tank 3.

2) According to a second cleaning mode, or automatic cleaning mode, the machine 100 enables automatic cleaning of painting tools. For this purpose, the painting tools are stowed by the operator in the cleaning device 10. The operator, suitably acting on the control means 15, starts the cleaning device 10 (causing the second solenoid valve EL2 to open and the third pump P3 to start) according to a desired cleaning program, for example setting the duration of the cleaning cycle, the number of cleaning cycles to be performed, and the water temperature in the cleaning device 10.

[0037] Preferably, the manual cleaning mode may be executed at the same time as the automatic cleaning mode.

[0038] A cleaning water transfer cycle transfers cleaning water from the third tank 3 to the hopper 5.

[0039] The cleaning water transfer cycle is automatically started when the third minimum level sensor S3b detects a water level in the third tank 3 equal to or greater than the minimum level. The signal from the third minimum level sensor S3b is processed by the management means 13 which, when the water level in the third tank 3 is equal to or greater than the minimum level, starts the fourth pump P4; the cleaning water present in the third tank 3 is thus transferred to the hopper 5.

[0040] The cleaning water transfer cycle is automatically stopped when the fifth maximum level sensor S5a detects a water level in the hopper 5 equal to the maximum level. The signal from the fifth maximum level sensor S5a is processed by the management means 13 which, when the water level in the hopper is equal to the maximum level, stops the fourth pump P4.

Cleaning water treatment cycle

[0041] A cleaning water treatment cycle allows sludge to be separated from the cleaning water and to obtain purified water to be reused in the cleaning cycle.

[0042] The cleaning water treatment cycle comprises a flocculation sub-cycle that enables flakes to be formed in the cleaning water present in the hopper 5.

[0043] "Flocculation" refers to a process by which non-sedimentable, non-filterable suspended substances present in an aqueous solution are aggregated together, thus forming so-called "flakes"; by virtue of their weight, the flakes are deposited at the bottom of the reactor in

which the process takes place, i.e., for the present machine, at the bottom of the hopper 5.

[0044] The flocculation sub-cycle is automatically started when the cleaning water level in the hopper 5 reaches the maximum level. For this purpose, the fifth maximum level sensor S5a detects the cleaning water level in the hopper 5 and transmits the corresponding signal to the management means 13. The management means 13 process the signal and activate the first dosing pump VD1 to dose a predefined amount of flocculant agents from the flocculant reservoir 6a to the hopper 5. At the same time, the management means 13 activate the second dosing pump VD2 to dose a predefined amount of chlorine from the chlorine tank 6b to the first tank 1.

[0045] Advantageously, the machine 100 allows just enough flocculant to be added to form a stable flake. However, in the prior art, flocculant is added in excess to compensate for fluctuations in the process and to prevent the degradation of the water quality; however, overdosing in flocculant has drawbacks such as the phenomenon of re-stabilization of suspended particles and, obviously, increased process costs.

[0046] At the same time, the management means 13 operate the stirrer 12 for a predefined time interval, alternating stop intervals.

[0047] These operations activate, in the cleaning water, a process of separation of the solid part from the liquid part, promoting the formation of flakes in the hopper 5; these, due to the increased weight, precipitate to the bottom of the hopper 5, leaving the cloudy water in the upper part of said hopper.

[0048] The cleaning water treatment cycle further comprises a cloudy water discharge sub-cycle, in which the cloudy water from the hopper 5 is discharged into the first tank 1. For this purpose, the management means 13 actuate the third solenoid valve EL3, allowing a portion of cloudy water to be discharged by gravity into the first tank 1.

[0049] The cleaning water treatment cycle further comprises a clarification sub-cycle, in which the cloudy water from the first tank 1 undergoes a clarification process to obtain purified water for reuse in the cleaning cycle.

[0050] For this purpose, the management means 13, at the same time as the operation of the third solenoid valve EL3 during the cloudy water discharge sub-cycle, actuate the first pump P1 to send water from the first tank 1 to the clarification unit 11, according to a clarification schedule, such as for a predefined time interval.

[0051] In the clarification unit 11, the water undergoes a clarification treatment, passing through the quartzite filters 11a and activated carbon filters 11b, and then is discharged back into the first tank 1.

[0052] The clarification unit 11 is also equipped with two solenoid valves for cleaning and backwashing the filters. This process may be manually activated by the operator.

[0053] The cleaning water treatment cycle further com-

prises a compaction sub-cycle, in which the flakes formed in flocculation undergo a process to obtain wet sludge.

[0054] For this purpose, the management means actuate the fourth solenoid valve EL4, which thus allows the flakes deposited at the bottom of the hopper 5 to be discharged into the boiler 7, along with, obviously, a portion of cloudy water. In the boiler 7, the flakes are heated according to a predefined heating cycle, such as to a predefined temperature for a predefined time interval, resulting in wet sludge.

[0055] When the process is finished and after a cooling interval, the management means 13 actuate the fifth solenoid valve EL5 to discharge the contents of the boiler 7 into the sludge collection drawer 8.

[0056] The sludge collection drawer 8 comprises a sieve, for example made of microperforated mesh, which retains the wet sludge and drains the residual water into the fourth tank 4 below. The resulting wet sludge is left to dry, for example for about 48 hours. For example, upon completion, sludge with 60% moisture content is obtained.

[0057] Furthermore, preferably, the sludge collection drawer 8 is equipped with a drawer presence sensor which, via the management means 13, signals to the operator that the sludge collection drawer 8 is properly inserted.

[0058] The sludge collection drawer 8 is removable and separable from the rest of the machine so that the operator may deliver the sludge to landfill.

[0059] The cleaning water treatment cycle further comprises a sub-cycle for transferring residual water from the fourth tank 4 to the first tank 1. For this purpose, the fourth minimum level sensor S4b detects the residual water level in the fourth tank 4 and transmits the corresponding signal to the management means 13. The management means 13 process the signal and, when the level is at or above the minimum level, activate the fifth pump P5 to transfer the remaining water from the fourth tank 4 to the first tank 1. In the first tank 1, the residual water thus joins the cloudy water and goes through the clarification sub-cycle mentioned above.

[0060] The machine according to the present invention meets the needs of the industry and overcomes the drawbacks mentioned with reference to the prior art, as it allows a limited volume of sludge to be sent for disposal instead of large quantities of cleaning water, thus greatly limiting the cost of disposal.

[0061] Furthermore, advantageously, the purified water is reused for cleaning additional utensils, so that the cleaning operations are environmentally sustainable.

[0062] According to another advantageous aspect, moreover, the machine is compact and space-saving, so that a sufficient number of these machines may be available in a workroom.

[0063] It is clear that a person skilled in the art, in order to satisfy current needs, could make modifications to the machine described above, said modifications all being contained within the scope of protection as defined in the

following claims.

Claims

1. A machine (100) for cleaning painting tools and treating tool cleaning water, comprising a support structure, a second tank (2), a hopper (5), a flocculant reservoir (6a) for containing flocculant agents, a boiler (7), a sludge collection drawer (8), a sink (9) with a tap (9a) for manually cleaning the tools and/or a cleaning device (10) for automatically cleaning the tools, all or in part supported by said support structure, and electronic management means (13) configured or programmed to manage a cleaning cycle of the tools and a treatment cycle of the cleaning water, wherein:

- the second tank (2) is intended to contain water to be used for cleaning the tools and is fluidically connected to the tap (9a) of the sink (9) and/or to the cleaning device (10), for feeding water thereto;

- the hopper (5) is configured to collect cleaning water of the sink (9) and/or of the cleaning device (10) and is operatively connected to the flocculant reservoir (6a) to receive flocculant agents to subject the cleaning water to a flocculation process which leads to the formation of flakes in cloudy water;

- the boiler (7) is fluidically connected to the hopper (5) to receive the flakes and the cloudy water and is configured to carry out a compacting process to obtain wet sludge from the flakes heated according to a predefined heat cycle;

- the sludge collection drawer (8) is connected to the boiler (7) to receive the wet sludge and discharge residual water into a first tank (1).

2. A machine according to claim 1, comprising the sink (9) with a tap (9a) and the cleaning device (10).

3. A machine according to claim 1 or 2, comprising a mechanical stirrer (12) configured to cooperate with the hopper (5) to facilitate stirring.

4. A machine according to any one of the preceding claims, comprising an electrical resistor (R1) cooperating with the second tank (2) to heat the water contained in the second tank (2).

5. A machine according to any one of the preceding claims, comprising a first dosing pump (VD1) for dosing the flocculant agents from the flocculant reservoir (6a) to the hopper (5).

6. A machine according to any one of the preceding claims, comprising a chlorine tank (6b) for containing

chlorine, operatively connected to the first tank (1), and a second dosing pump (VD2) for dosing the chlorine from the chlorine tank (6b) to the first tank (1).

7. A machine according to any one of the preceding claims, wherein the first tank (1), supported by the support structure, is intended to contain tool cleaning water and is fluidically connected to the second tank (2) to feed water thereto. 5
8. A machine according to claim 7, wherein the first tank (1) is configured to receive the residual water from the sludge collection drawer (8). 10
9. A machine according to any one of the preceding claims, comprising a clarification unit (11), supported by the support structure, for carrying out a water clarification process, said clarification unit (11) being fluidically connected to the first tank (1) to receive water to be clarified from the first tank (1) and transfer clarified water to the first tank (1). 15 20
10. A machine according to claim 9, wherein the clarification unit (11) comprises a plurality of filters (11'), said plurality of filters (11) comprising, for example, filters with quartzite (11a) and/or filters with active carbons (11b). 25
11. A machine according to any one of claims 7 to 10, comprising a fourth tank (4), supported by the support structure, fluidically interposed and connected to the boiler (7) and to the first tank (1) to collect the residual water transferred from the boiler (7) and transfer it to the first tank (1). 30 35
12. A machine according to any one of the preceding claims, wherein the hopper (5) is fluidically connected to the first tank (1) to transfer therein the cloudy water formed during flocculation. 40
13. A machine according to any one of the preceding claims, comprising a third tank (3), supported by the support structure, fluidically connected and interposed between the sink (9) or the cleaning device (10) and the hopper (5) to collect the cleaning water originating from the sink (9) or from the cleaning device (10) and transfer it to the hopper (5). 45
14. A machine according to any one of the preceding claims, comprising display means (14) for displaying operating parameters or an operating status of the machine, which are operatively connected to the management means (13). 50
15. A machine according to any one of the preceding claims, comprising control means (15) for imparting commands to the machine, which are operatively connected to the management means (13). 55
16. A machine according to any one of the preceding claims, wherein the sludge collection drawer (8) comprises a sieve, for example consisting of a microperforated mesh, to separate the wet sludge from the residual water.
17. A machine according to any one of the preceding claims, wherein the sludge collection drawer (8) is removable and separable from the machine to dispose of the sludge.
18. A method for cleaning painting tools and treating tool cleaning water by means of a machine (100) made according to any one of the preceding claims.
19. A method for cleaning painting tools and treating tool cleaning water, comprising a cleaning water treatment cycle, wherein said cleaning water treatment cycle comprises a compaction sub-cycle, in which flakes formed in a flocculation of the cleaning water are subjected to heating in a boiler to obtain wet sludge.

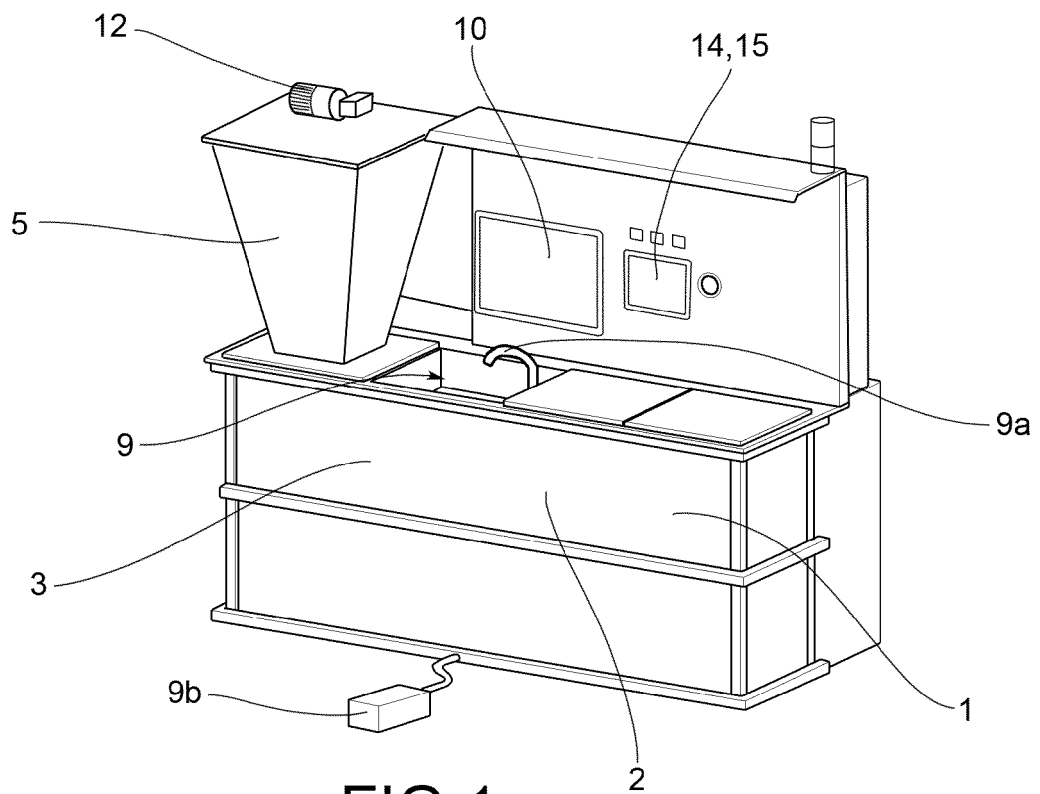


FIG.1

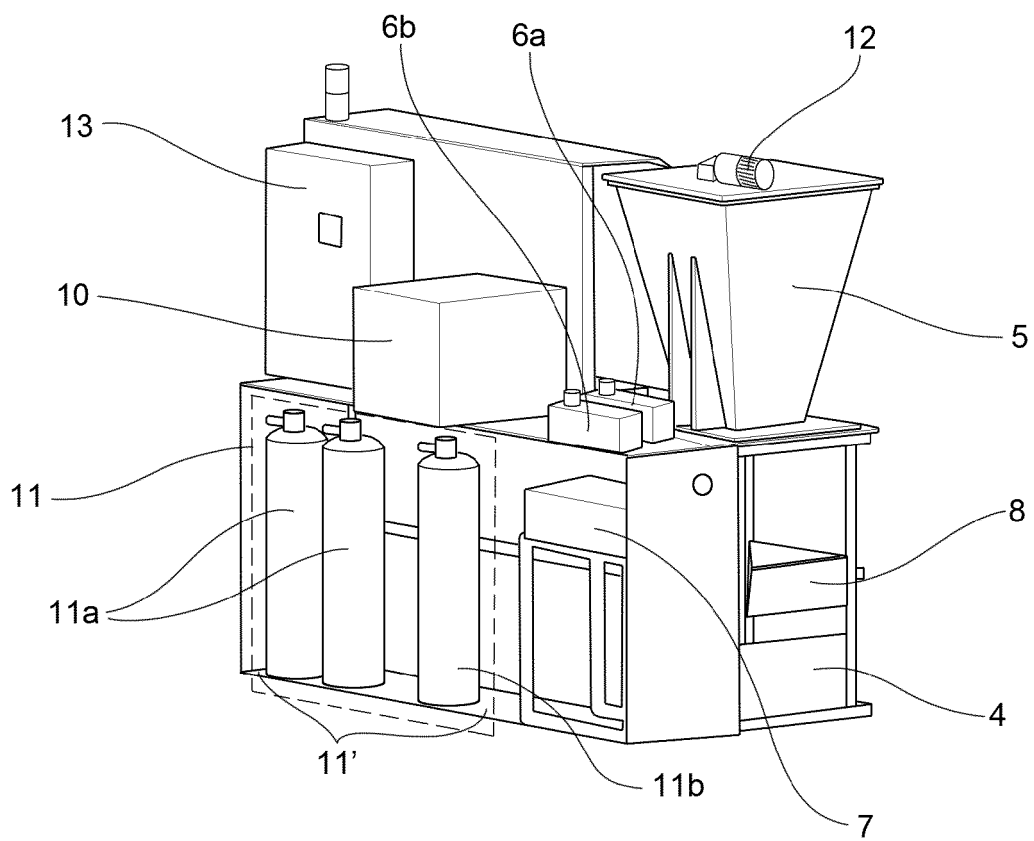


FIG.2

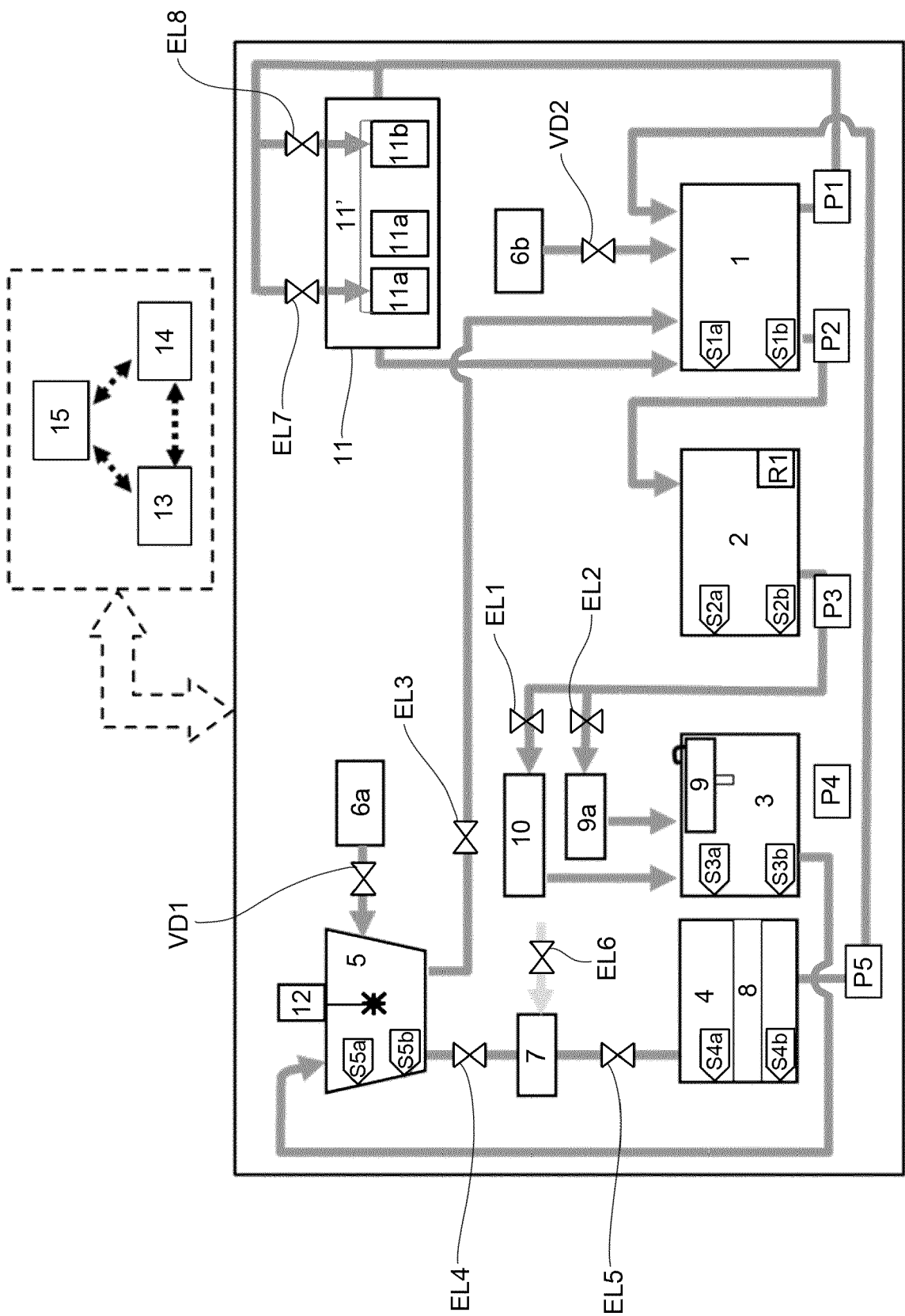


FIG.3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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