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(54) Machine for treating laundry, particularly a washer-drier machine with recirculation circuit

(57) A washer-drier machine (1) for washing and drying laundry comprises a washing tank (3) and a laundry basket (5) which is pivotally supported within the washing tank (3), a drying circuit (16, 17, 18, 19, 20, 21) with a suction unit (17, 18), a heat exchanger (19, 20) and a heating unit (21) which communicate with each other by means of a drying duct (16), a discharge circuit (9, 10) being at least partially arranged underneath the bottom (8) of the washing tank (3) and containing an additional liquid volume (16) arranged underneath the laundry basket (5), a recirculation circuit (17, 18) connected to the washing tank (3) and to the discharge duct (9, 10) in a point underneath the tank bottom (8), such as to be capable of conveying at least one part of the additional liquid volume (16) to the washing tank (3).

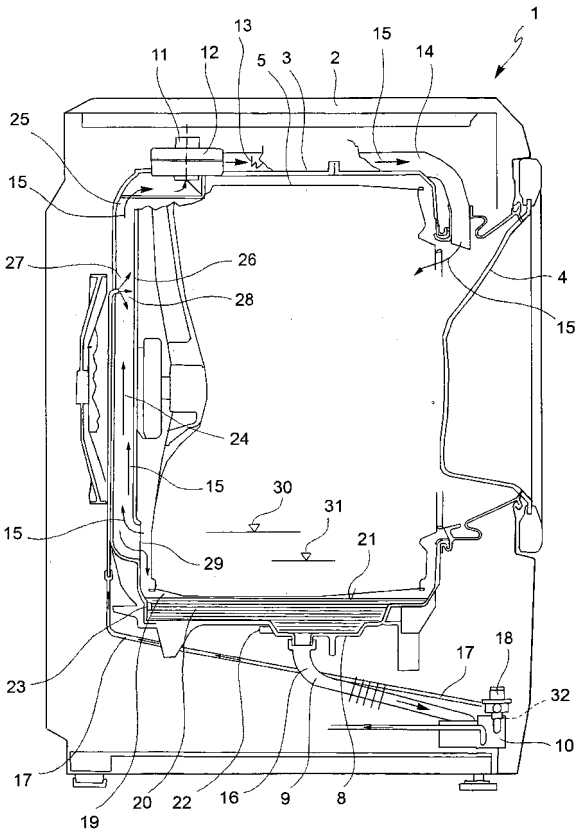

FIG. 1

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Description

[0001] The present invention relates to a machine for treating laundry, particularly a domestic washer-drier machine which provides for washing and drying the laundry.

[0002] Domestic washer-drier machines are known to comprise a support and housing structure, a washing tank being housed therein, which is provided with a front opening that can be closed by means of a porthole door that is hinged in front of the housing. Within the washing tank, a basket is pivotally housed about a horizontal or inclined axis, for the laundry to be accommodated therein to be washed and/or dried. The basket also defines a front opening that is located such as to match the opening of the washing tank, in order to load/unload the laundry.

[0003] The washing tank is suitable to contain the washing liquid during the laundry washing steps and to be a portion of the drying circuit during the laundry drying step.

[0004] A washing water delivery system that can be connected to the water supply is provided in order to load the tank with mains water and detergent substances and additives. This washing water delivery system comprises a plurality of electrovalves suitable to selectively adjust the supply to a plurality of flow paths extending downstream of these electrovalves through respective compartments of a detergent tray to the washing tank. On the bottom of the washing tank, a drain duct is provided with a discharge pump being associated therewith, which provides for the removal of the washing liquid from the tank and controls, together with the supply electrovalves, the level of liquid within the tank. An electric resistance being arranged within the tank in the gap between the tank wall and laundry basket is provided to heat the washing liquid contained in the tank.

[0005] The drying circuit of prior art washer-drier machines typically comprises a suction unit, a heat exchanger and a heating unit with electric resistances communicating with each other by means of a drying duct.

[0006] In such a closed loop circuit, the air flow generated by the suction unit is heated by the electric resistances and blown to the basket, where it causes the water contained within the tissues to evaporate as it passes through the wet laundry. In the heat exchanger, which is generally a container separate from the washing tank and provided with a spray nozzle, the wet air is cooled by a jet of cold water. Due to this cooling, the vapour condensates and is collected and discharged together with the cooling water. The dehumidified air is then sucked again by the suction unit and recirculated.

[0007] The cooling water is usually supplied to the heat exchanger by means of a cooling duct with a dedicated electrovalve which controls the loading of the mains water to the heat exchanger (condenser).

[0008] Prior art washer-drier devices, while being satisfying under many aspects, have a high consumption of water, electric power and detergent, during the washing and drying steps.

[0009] In fact, due to the arrangement required for the discharge duct and discharge pump underneath the bottom of the washing tank, the volume of the liquid accommodated within the discharge duct and on the tank bottom is destined to be completely unused and is just discharged in the wastewater network.

[0010] Consequently, along with the unused liquid volume, the detergent or additive dissolved in this liquid volume and the heat (in case of washing) and frigories (in case of drying) that are contained within the liquid are also unused.

[0011] The object of the present invention is thus to provide a washer-drier machine, having such characteristics as to decrease the waste of water, detergent, additives and electric power that is due to unused liquid volumes during the laundry washing, rinse and drying operations.

[0012] This and other objects are achieved by means of a washer-drier machine according to claim 1. Advantageous embodiments are the object of the dependent claims.

[0013] According to the invention, the washer-drier machine comprises:

[0014] - a laundry basket being supported within a washing tank suitable to contain the washing liquid;

[0015] - a discharge circuit with a discharge duct and a discharge pump, which is at least partially arranged underneath the bottom of the washing tank and in fluid communication with said tank bottom, such as to be capable of discharging the liquid contained within the washing tank,

[0016] wherein said discharge circuit defines a space which, in the operating condition of the washer-drier machine, contains an additional liquid volume being arranged below the laundry basket,

[0017] characterized in that it comprises a recirculation circuit with a recirculation duct and pump means, which is connected to said washing tank and said discharge circuit in a location below the tank bottom, such as to be capable of conveying at least one part of the additional volume into the washing tank.

[0018] The additional liquid volume being conveyed to the tank, which would be otherwise unused, this additional liquid, together with the load of detergent, additive and heat thereof, is admixed with the liquid volume being directly in contact with the laundry, thereby allowing for an improved exploitation of the resources and a decrease in the pollutants being released in the environment.

[0019] According to an aspect of the present invention, the recirculation circuit is connected to the washing tank in a location above the level as defined by the lower side of the basket, and preferably, above the predetermined liquid level for the washing steps. Thereby, a high concentration is obtained for the load of heat and detergent and additive of the portion of additional liquid being recirculated in the upper area of the liquid contained in the washing tank, and thus, in a portion of liquid that is particularly involved in the treatment of laundry.

[0020] In accordance with a further aspect of the invention, the recirculation circuit is connected to the condenser of the drying circuit, such as to supply, during the drying step, said condenser with cooling liquid that is taken from said additional liquid volume. The condenser can be, in turn, connected to the washing tank, such as to obtain, during the washing operation, the admixing of the washing water, and during the drying step, the cooling liquid together with the condensate are collected on the tank bottom and underlying discharge circuit, from where they can be discharged or conveyed (recirculated) again to the condenser. Thereby, the natural cooling of the additional liquid volume within the discharge circuit can be exploited to the purpose of condensation and, hence, the amount of fresh water required for drying the laundry can be reduced.

[0021] According to a still further aspect of the invention, the washing tank defines therein a condensation space suitable to contain a cooling water volume that forms a free water surface spaced away from the basket such as to be capable of cooling the drying air flow downstream of the basket within the washing tank. This cooling free water surface can be either added to a "traditional" condenser or entirely replace the latter.

[0022] Since a cooling water volume is maintained within the washing tank, a continuous use of a same water volume will be allowed until the latter is heated past an upper threshold temperature for condensation purposes. This results in a considerable saving of cooling water during the drying step.

[0023] Of course, the cooling water volume within the tank and discharge circuit, which exactly corresponds to the additional water volume, has a thermal gradient given by the difference between the temperature of the hot laundry within the basket and that of the cooler external environment. Due to said recirculation circuit, the further synergic effect is obtained, which, during the drying step, the cooler portion of the cooling water volume is recirculated and mixed with the warmer portion directly involved in the condensation process.

[0024] Further advantageous aspects of the invention will appear from the following description of several embodiments thereof, which are given by way of nonlimiting example, with reference to the attached figures, in which:

[0025] - Fig. 1 is a side sectional view of a washer-drier machine according to an embodiment of the invention;

[0026] - Fig. 2 is a front sectional view of the washer-drier machine in Fig. 1;

[0027] - Fig. 3 is a side sectional view of a washer-drier machine according to a further embodiment of the invention;

[0028] - Fig. 4 is a front sectional view of the washer-drier machine in Fig. 3;

[0029] - Fig. 5 illustrates a diagram of a filtering system of the washer-drier machine according to an embodiment of the invention;

[0030] - Fig. 6 illustrates a diagram of a filtering system of the washer-drier machine according to an embodiment of the invention.

[0031] With reference to the figures, a washer-drier machine 1 comprises a support and housing structure 2, a washing tank 3 being housed therein, which is provided with a front opening that can be closed by means of a porthole door 4 being hinged to the front of the housing 2. Within the washing tank 3, a basket 5 is pivotally housed about a horizontal or inclined axis, for the laundry to be accommodated therein to be washed and/or dried. The basket 5 also defines a front opening that is located such as to match the opening of the washing tank 3, in order to be capable of carrying out the loading/unloading of the laundry.

[0032] The washing tank 3 is suitable to contain the washing liquid during the laundry washing steps, and to be a portion of the drying circuit during the laundry drying step.

[0033] A washing water delivery system that can be connected to the water supply is provided in order to load the tank 3 with mains water and detergent substances and additives. This washing water delivery system comprises a plurality of washing flow paths extending from, for example, two supply electrovalves (not illustrated) through corresponding compartments 6 of a detergent tray 7 to the washing tank 3.

[0034] On the bottom 8 of the washing tank 3, there is connected a drain duct 9, with a discharge pump 10 associated therewith and being arranged underneath the tank bottom 8, which provides for the removal of the washing liquid from the tank 3 and controls, together with the supply electrovalves, the level of liquid within the tank 3.

[0035] To heat the washing liquid contained within the tank 3, a coiled electric resistance is provided, which is arranged within the tank 3, particularly on the bottom 8 of the latter, in the gap between the tank wall 3 and the laundry basket 5.

[0036] The washer-drier machine 1 further comprises a closed-loop drying circuit with a suction unit, for example an fan impeller 11 driven by an electric motor 12, a heat exchanger as well as a heating unit with electric resistance 13, which communicate with each other by means of a drying circuit 14.

[0037] In such a loop circuit, the air flow 15 generated by the suction unit 11, 12 is heated by the electric resistance 13 and blown to the basket 5, where it causes the water contained within the tissues to evaporate as it passes through the wet laundry. The heat exchanger is arranged downstream of the laundry basket 5 (with reference to the direction of the drying air flow 15) and cools the wet air flowing from the basket 5.

[0038] Due to this cooling, the vapour condensates and is collected and discharged, for example together with a cooling water volume. The dehumidified air is then sucked again by the suction unit 11,12 and recirculated.

[0039] The discharge circuit (discharge duct 9 and discharge pump 10) defines, along with the tank bottom 8, a space that, in the operating condition of the washer-

drier machine 1, contains an additional liquid volume 16 that is arranged below the laundry basket 5.

[0040] Advantageously, a recirculation circuit with a recirculation duct 17 and pump means, for example a recirculation pump 18 is connected to the washing tank 3 and with said discharge circuit 9, 10 in a point below the tank bottom 8, such as to be capable of at least partially conveying the additional liquid volume 16 to the washing tank 3.

[0041] The additional liquid volume 16 being conveyed to the tank 3, which would be otherwise unused, this additional liquid 16 together with the load of detergent, additive and heat thereof, is admixed with the liquid volume being directly in contact with the laundry, thereby allowing for an improved exploitation of the resources and a decrease in the pollutants being released in the environment.

[0042] According to an embodiment (Fig. 1, 2) the recirculation circuit is connected to the discharge circuit in the vicinity of the discharge pump 10 or directly thereto, which pump is usually arranged in the lowermost point of the whole discharge circuit. Thereby, substantially the whole additional liquid volume 16 can be fed back to the washing tank 3, and thus the thermal gradient and the detergent and additive contents can be better used, with great advantage in terms of drying and washing of laundry, as will be detailed below. According to a further development of this embodiment, the recirculation pump 18 is connected to the discharge pump 10 (by means of the piping of the discharge and recirculation ducts or by dedicated connection members) such that the recirculation pump is structurally supported by the discharge pump, and thus does not require further support means.

[0043] In accordance with a further embodiment (Fig. 3, 4), the recirculation pump 18 is connected (by means of the piping of the discharge circuit or by means of suitable connection members) to the washing tank 3, preferably to the tank bottom 8, whereas the connection point between the discharge circuit and the recirculation circuit can be either in the vicinity of the tank bottom or even much spaced from the latter.

[0044] A mechanical connection of the recirculation pump to the tank bottom 8 allows using the same support and shock-absorbing components as the tank-basket unit for supporting the recirculation pump 18.

[0045] According to an embodiment of the invention, the washing tank 3 defines a condensation space 19 therein, which is suitable to contain a cooling water volume 20 that forms a free water surface spaced away from the basket 5 such as to be capable of cooling the drying air flow 22 downstream of the basket 5 within the washing tank 3.

[0046] Advantageously, this condensation space 19 is formed at the tank bottom 8, approximatively below the basket 5.

[0047] Thereby, the whole supply circuit of the condenser can be eliminated, as the latter can be easily supplied with mains water loaded by the washing water loading circuit, since it consists of a free surface of a water volume 20 (condensation surface) within the washing tank 3.

[0048] Furthermore, as the cooling water volume 20 in the washing tank 3 is maintained, a continuous use of a same water volume is allowed until the latter is heated past a threshold temperature sufficient for condensation purposes. This results in a considerable saving of cooling water during the drying step.

[0049] Obviously, due to the inevitable filling of the discharge circuit 9, 10 with cooling liquid, the cooling liquid also has said additional liquid volume 16 with a thermal gradient that is determined by the difference between the highest temperature of the condensation surface that is exposed to the hot air flow 15 and the lowest temperature of the farthermost areas from the basket 5.

[0050] Due to the recirculation circuit 17, 18, during the drying step, the coldest portion of the cooling water volume is fed back into the washing tank 3, and then admixed with the warmest cooling water portion that is directly involved in the condensation process.

[0051] Thereby, a gradually even heating can be obtained for the entire cooling water volume 20, and thus, the refrigerating capacity thereof can be better used for condensation purposes.

[0052] **Description of devices and methods for controlling the drying program as a function of temperature and/or level of the condensation surface**

[0053] The washer-drier machine 1 comprises a control unit (not shown in the drawings) which allows setting a drying program that carries out the following steps:

[0054] - arrangement of the cooling water volume 20 such that the free water surface 21 is left out of the basket bulk 5;

[0055] - control of the water level such that, during the drying step, due to the formation of the condensate, the free water surface 21 does not exceed a predetermined upper level and/or

[0056] - control of the temperature of the cooling water volume 20 such that, during the drying step, due to the thermal exchange with the drying air flow 15, the temperature of the water volume 20 does not exceed a predetermined upper temperature value above which the difference of temperature between the condensation surface 21 and the drying air flow 15 is no longer sufficient to condensation purposes.

[0057] According to an embodiment, the step of controlling the cooling water level 20 comprises the step of detecting a value indicative of the cooling water level 20 and at least partially draining the cooling water 20 through the drain duct 9, when the cooling water level 20 exceeds said upper level.

[0058] Advantageously, the operation of detecting a value indicative of the cooling water level 20 is carried out by means of a pressure sensor 22 that is arranged at the tank bottom 8. This pressure sensor 22 (e.g., a so-called pressure switch) generates a pressure signal and sends it to the control unit that, in turn, controls the dis-

charge pump 10 and causes the latter to at least partially drain the cooling water 20 and condensate from the washing tank 3. Alternatively, the pressure sensor 22 directly interacts with the power supply of the discharge pump 10 and causes the partial or total drainage of the tank 3 in response to the attainment of a determined water level, for example the above-cited upper level.

[0059] In accordance with a further embodiment, the control of the cooling water level 20 can be carried out with one or more level sensors (such as a sensor using the electrical conductivity of the cooling water 20) that are connected to the control unit and/or directly to the discharge pump 10.

[0060] Advantageously, the washer-drier machine and the washing and drying programs thereof are configured such that the control of the cooling water level 20 during the drying step and the control of the washing liquid level during the washing and rinse steps are carried out by means of a same pressure sensor 22 or group of level sensors.

[0061] Alternatively to what has been described above, the control of the cooling water level 20 can be carried out by at least partially draining this water, at preset time intervals, wherein the duration of these intervals is determined, for example, on the basis of a series of tests or numerical simulations and takes into account the condensate accumulation on the tank bottom.

[0062] According to an embodiment, the process step of controlling the temperature of cooling water 20 comprises the step of detecting the temperature or a entity indicative of the temperature of the cooling water 20 and at least partially discharging the cooling water 20 through the drain duct 9 and feeding a corresponding amount of fresh mains water in the washing tank 3, when the temperature detected exceeds said upper value.

[0063] Advantageously, the operation of detecting the temperature of the cooling water 20 is carried out by means of a temperature sensor 23 arranged in the vicinity of the tank bottom 8. This temperature sensor 23 generates a temperature signal and sends it to the control unit, which, in turn controls the drain pump 10 and the supply electrovalves.

[0064] When the upper temperature is reached or exceeded, the control unit causes the drain pump 10 to at least partially remove the cooling water 20 and condensate from the washing tank 3 and, subsequently, it opens the supply electrovalve to feed a corresponding amount of cold mains water, preferably through the same water supply duct used during the washing step. Alternatively, the temperature sensor 23 directly interacts with the power supply of the discharge pump 10 and supply electrovalves and causes the partial or total replacement of the cooling water 3 in response to the fact that the upper temperature has been either attained or exceeded.

[0065] Advantageously, the washer-drier machine and the washing and drying programs are configured such that the control of the temperature of the cooling water 20 during the drying step and the control of the temperature of the washing liquid during the washing and rinse steps are carried out by means of a same temperature sensor 23 or groups of temperature sensors.

[0066] Alternatively to what has been described above, the control of the temperature of the cooling water 20 can be carried out by at least partially replacing this water, at preset time intervals, wherein the duration of these intervals is determined, for example, on the basis of a series of tests or numerical simulations and takes into account the temperature increase in the mixture of cooling water and condensate on the tank bottom 8.

[0067] **Description of devices and methods for controlling the function of recirculation and admixture of the cooling liquid during the drying operation**

[0068] While the partial or complete discharge and respective reload of cooling water is advantageously carried out based on the temperature and at the level of the condensation surface 21, the control unit of the washer-drier machine 1 or a local control unit of the recirculation pump 18 controls the electric power supply of the recirculation pump 18 such as to carry out the recirculation of the additional liquid volume 16 and the admixture of the latter with:

[0069] - the volume of cooling water 20 within the washing tank 3 in a continuous manner, or sequential manner during at least one step of the drying program; and/or

[0070] - the volume of washing and/or rinse liquid within the washing tank 3 in a continuous manner or sequential manner during at least one step of the washing and/or rinse program.

[0071] In accordance with an embodiment, the control unit controls the loading of mains water, the drainage of cooling liquid and condensate and the recirculation of the additional liquid volume, such as to avoid exceeding a determined maximum water level within the tank, said maximum level being lower than the lower side of the basket 5, and to recirculate an amount of water that, when the recirculation pump is deactivated, would increase the water level in the tank beyond said maximum level and beyond the lower side of the basket 5.

[0072] According to an embodiment, the washing tank 3 which is preferably moulded from plastics, defines therein a suction portion 24 of the drying duct 14, i.e. the duct portion arranged downstream of the heat exchanger (consisting of the free surface 21 of the cooling water 20 on the tank bottom 8) and upstream of the suction unit 11, 12.

[0073] In accordance with an embodiment, this suction duct 24 extends within the washing tank 3 from a lower area thereof to an opening 25 in the upper area thereof and is defined by a portion of the inner surface of the tank 3 and by a lid 26 that is separately manufactured and subsequently connected to the inner surface of the washing tank 3.

[0074] Thereby, the same washing tank 3 can be advantageously used both with washing machines without drying function (without the inner lid 26), and with drier-washer machines (with the inner lid 26).

[0075] In accordance with a further embodiment (Fig. 1 - 4), the washer-drier machine 1 comprises, in addition to the heat exchanger consisting of the cooling water volume 20 on the tank bottom 8, a further heat exchanger 27, which is preferably arranged downstream of the first heat exchanger 19, 20 (with reference to the flow direction of the drying air 15) and provided with a cooling device, such as a spraying nozzle 28 or cooling coil (not shown) that can be supplied by means of the recirculation circuit 17, 18 with cooling liquid being taken from the discharge circuit 9, 10.

[0076] Consistently with the aspects of the invention as described above, it is particularly advantageous when the further heat exchanger 27 is connected to the washing tank 3, such that, during the washing operation, the admixture of the washing water is obtained, and during the drying step (and also considering possible embodiments without condenser with free water surface 19, 20, 21), the cooling liquid together with the condensate, are collected on the tank bottom 8 and in the discharge circuit 9, 10 therebelow, from where they can be either discharged or conveyed again (recirculated) to the heat exchanger 27.

[0077] On the other hand, referring back to the embodiment (Fig. 1, 2) providing the presence of the free water surface condenser 19, 20, 21 and further heat exchanger 27, the recirculation of the additional liquid volume 16 in the further heat exchanger 27 and from the latter to the cooling liquid volume 20 on the tank bottom 8, allows mixing the whole cooling liquid volume and passing the latter through two condensation stages.

[0078] According to an aspect of the present invention, the recirculation duct 17 is connected to the washing tank in a point above the level being defined by the lower side of the basket 5, and preferably, above the predetermined liquid level for the washing steps. Thereby, even during the washing step, a high concentration is obtained for the load of heat and detergent and additive of the portion of additional liquid 16 being supplied again in the upper area of the liquid contained in the washing tank 5, and thus, in a portion of liquid that is particularly involved in the treatment of laundry.

[0079] In accordance with a further embodiment, the lower suction opening 29 of the suction portion 24 is arranged below a level of rinse liquid 30 during a rinse step, and preferably, this suction opening 29 is arranged at or below a washing liquid level 31 during a washing step. This configuration facilitates the cleaning of the suction duct during the washing and rinse operations.

[0080] In accordance with a further embodiment, the washer-drier machine comprises a particulate filter 32 arranged upstream of the discharge pump 10 and suitable to hold the sediments and limestone that are contained in the liquid that is intended to be discharged, in order to avoid damaging and jamming the rotor of the discharge pump 10. In order to allow catching the sediments contained within the liquid intended to be recirculated within the tank, the recirculation pump 18 can be arranged downstream of the particulate filter 32 and upstream of the discharge pump 10 (with reference to the direction of the discharge flow), such that the same particulate filter 32 holds the particulate both during the recirculation and during the discharge of the liquid, thereby consequently protecting both pumps (Fig. 5).

[0081] According to an alternative embodiment, the particulate filter 32 is configured such as to divide the discharge duct 9 into branches upstream of the discharge pump 10 and recirculation pump 18, and comprises a first particulate catching device 33 that is arranged in the inlet flow of the discharge pump 9 and a second particulate catching device 34 (distinct from the first particulate catching device 33) and arranged in the inlet flow of the recirculation pump 18. This allows designing both particulate catching devices 33, 34 in a targeted manner for each one of the discharge and recirculation pumps (Fig. 6).

[0082] In accordance with a further development of the filtering system, both particulate catching devices 33, 34 are associated with a same single particulate collection chamber 35. This allows, on the one side, a targeted filtering and differentiated according to the discharge and recirculation functions, and on the other hand, emptying only one container when cleaning the filter.

[0083] From the description given above, those skilled in the art may appreciate that the recirculation circuit 17, 18 is advantageous both for washer-drier machines (since the synergic effect is obtained of best using the thermal characteristics and the laundry treatment substances during the washing and drying steps) and for washing machines (in which the recirculation allows a better use of the thermal energy of the washing liquid and substances dissolved therein).

[0084] The machine for treating the laundry according to the invention, particularly in the embodiment of washer-drier machine has a number of advantages.

[0085] It allows an improved mixing of the detergent and additives each time mains water is loaded, an even distribution of the temperature of the washing bath, an even distribution of the temperature in the cooling liquid, the cleaning of the condensation duct and the removal of residues deriving from the drying program during the drying, washing and rinse steps. All the above results in saving water, electric power and detergent substances being required for treating the laundry.

[0086] Obviously, to the machine for treating laundry, particularly a washer-drier, according to the present invention, those skilled in the art, aiming at meeting contingent and specific requirements, may carry out further modifications and variations, all being however contemplated within the scope of protection of the invention, such as defined in the annexed claims.

Claims

1. A washer-drier machine (1) for washing and drying

the laundry comprising:

- a washing tank (3) suitable to contain the washing liquid;
- a basket (5) suitable to accommodate the laundry and being pivotally supported within the washing tank(3);
- a drying circuit (11, 12, 13, 14, 19, 20, 24, 27, 28) with a suction unit (11, 12), a heat exchanger (19, 20, 27, 28) and a heating unit (13) which communicate with each other by means of a drying duct (14), said drying duct being suitable of delivering a drying air flow (15) through said basket (5),
- a discharge circuit (9, 10) with a discharge duct (9) and a discharge pump (10), which is at least partially arranged underneath the bottom (8) of the washing tank (3) and in fluid communication with said tank bottom (8), such as to be capable of discharging the liquid contained within the washing tank (3),

wherein said discharge circuit (9, 10) defines a space which, in the operating condition of the washer-drier machine (1), contains an additional liquid volume (16) being arranged below the laundry basket (5), **characterized in that** it comprises a recirculation circuit (17, 18) with a recirculation duct (17) and pump means (18), which is connected to said washing tank (3) and to said discharge circuit (9, 10) in a location below the tank bottom (8), such as to be capable of conveying at least one part of said additional volume (16) into said washing tank (3).

2. The washer-drier machine (1) according to claim 1, wherein the recirculation circuit (17, 18) is connected to the discharge circuit (9, 10) either in the vicinity of the discharge pump (10) or directly to the discharge pump (10).

3. The washer-drier machine (1) according to claim 2, wherein the recirculation pump (18) is connected to the discharge pump (10), such that the recirculation pump (18) is structurally supported by the discharge pump (10) .

4. The washer-drier machine (1) according to claim 1, wherein the recirculation pump (18) is supported by the washing tank (3).

5. The washer-drier machine (1) according to any preceding claim, wherein the recirculation circuit (17, 18) is connected to the heat exchanger (19, 20; 27, 28) of the drying circuit, such as to supply, during the drying operation, said heat exchanger (19, 20; 27, 28) with cooling liquid taken from said additional liquid volume (16).

6. The washer-drier machine (1) according to claim 5, wherein said heat exchanger (19, 20; 27, 28) is connected to the washing tank (3), such as to obtain, during the washing operation, the mixing of the washing water, and during the drying step, the cooling liquid along with the condensate is collected on the tank bottom (8) and in the underlying discharge circuit (9, 10), from where they can be conveyed again to the heat exchanger (19, 20; 27, 28).

7. The washer-drier machine (1) according to any preceding claim, wherein the washing tank (3) defines therein, at the tank bottom (8), a condensation space (19) suitable to contain a cooling water volume (20) that forms a free water surface (21) being spaced away from the basket (5) such as to be capable of cooling the drying air flow (15) downstream of the basket (5) within the washing tank (3), and wherein said recirculation duct (17, 18) is configured to feed again, during the drying step, at least part of the additional cooling water volume (16) to the washing tank (3) and admix it with the cooling water portion (20) forming said condensation surface (21).

8. The washer-drier machine (1) according to the preceding claim, comprising, in addition to the heat exchanger consisting of the cooling water volume (20) on the tank bottom (8), a further heat exchanger (27), which is preferably arranged downstream of the first heat exchanger (19, 20) in the direction of the drying air flow (15) and having a cooling device (28) that can be supplied by means of said recirculation circuit (17, 18) with cooling liquid that is taken from the discharge circuit (9, 10).

9. The washer-drier machine (1) according to the preceding claim, wherein said further heat exchanger (27) is connected to the washing tank (3), such that the cooling liquid of the further heat exchanger (27) is discharged to the washing tank (3).

10. The washer-drier machine (1) according to any preceding claim, wherein an outlet opening of the recirculation duct (17) is connected to the washing tank (3) in a point above the level being defined by the lower side of the basket (5).

11. The washer-drier machine (1) according to the preceding claim, wherein said outlet opening of the recirculation duct (17) is connected to the washing tank (3) in a point above the predetermined liquid level for the washing steps.

12. The washer-drier machine (1) according to any preceding claim, wherein a lower suction opening (29) of the drying duct (14) is arranged below a rinse liquid level (30) during a rinse step and at or below a wash-

ing liquid level (31) during a washing step.

13. The washer-drier machine (1) according to any preceding claim, comprising a particulate filter (32) arranged upstream of the discharge pump (10),
wherein the recirculation pump (18) is arranged downstream of the particulate filter (32) and upstream of the discharge pump (10) in the direction of the discharge flow, such that the same particulate filter (32) holds the particulate both during the recirculation and during the discharge of the liquid.

14. The washer-drier machine (1) according to any preceding claim, comprising a particulate filter (32), which is configured such as to divide the discharge duct (9) into branches upstream of the discharge pump (10) and recirculation pump (18), said particulate filter (32) comprising a first particulate catching device (33) being arranged in the inlet flow of the discharge pump (9) and a second particulate catching device (34) distinct from the first particulate catching device (33) and being arranged in the inlet flow of the recirculation pump (18),
wherein both particulate catching devices (33, 34) are associated with a same particulate collection chamber (35).

15. The washer-drier machine (1) according to any preceding claim, comprising level control means (22) which, during said drying step:

- arrange said cooling water volume (20) such that said free water surface (21) is left out of the basket bulk (5) ;
- control the cooling water level (20) such that, during the drying step, due to the formation of the condensate, the free water surface (21) does not exceed a predetermined upper level arranged below the basket (5).

16. The washer-drier machine (1) according to any preceding claim, comprising temperature control means (23) which, during said drying step:

- control the temperature of the cooling water volume (20) such that, during the drying operation, due to the thermal exchange with the drying air flow (15), the temperature of the water volume (20) does not exceed a predetermined upper temperature value above which the difference of temperature between the condensation surface (21) and the drying air flow (15) is no longer sufficient to condensation purposes.

17. The washer-drier machine (1) according to claim 15 or 16, wherein the level control means (22, 23) are configured such as to detect a value indicative of the cooling water value (20) and to at least partially drain the cooling water (20) through the drain duct (9), when the cooling water level (20) exceeds said upper level.

18. The washer-drier machine (1) according to any claim 3 to 5, wherein said level control means (22, 23) comprise a pressure sensor (22) arranged at the tank bottom (8).

19. The washer-drier machine (1) according to claim 15, wherein said level control means comprise timer means driving the drainage of at least a part of the cooling water volume (20) and condensate, at preset time intervals.

20. The washer-drier machine (1) according to any claim 16 to 19, wherein said temperature control means (23) are configured such as to detect, during this drying step, the temperature or a magnitude indicative of the temperature of the cooling water (20) and to at least partially drain the cooling water (20) and to feed a corresponding amount of fresh mains water to the washing tank (3), when the temperature or the indicative magnitude detected exceeds a value corresponding to said upper value.

21. The washer-drier machine (1) according to the preceding claim, wherein said temperature control means comprise a temperature sensor (23) arranged in the vicinity of the tank bottom (8).

22. The washer-drier machine (1) according to the preceding claim, wherein, in response to the attainment of said upper temperature value, said temperature sensor (23) generates a temperature signal and sends it to the control unit, which, in turn, controls the discharge pump (10) and the supply electrovalves and causes the latter to:

- at least partially remove the cooling water (20) and condensate from the washing tank (3) and,
- subsequently, feeding a corresponding amount of fresh mains water.

23. The washer-drier machine (1) according to claim 16, wherein said temperature control means comprise timer means that drive the replacement of at least a part of the cooling water (20), at preset time intervals.

24. The washer-drier machine (1) according to any preceding claim, wherein a control unit of the washer-drier machine (1) controls the power supply of the recirculation pump (18) such as to carry out the recirculation of the additional liquid volume (16) and the admixture of the latter with the cooling water volume (20) within the washing tank (3) in a continuous manner or sequential manner during at least one step of the drying program.

25. The washer-drier machine (1) according to the preceding claim, wherein the control unit drives the loading of the mains water, the drainage of the cooling liquid and condensate, and the recirculation of the additional liquid volume, such as to:

- not exceeding a determined maximum water level in the tank, said maximum water level being lower than the lower side of the basket (5),
- recirculating an amount of water that, when the recirculation pump is deactivated, would increase the water level in the tank beyond said lower side of the basket (5).

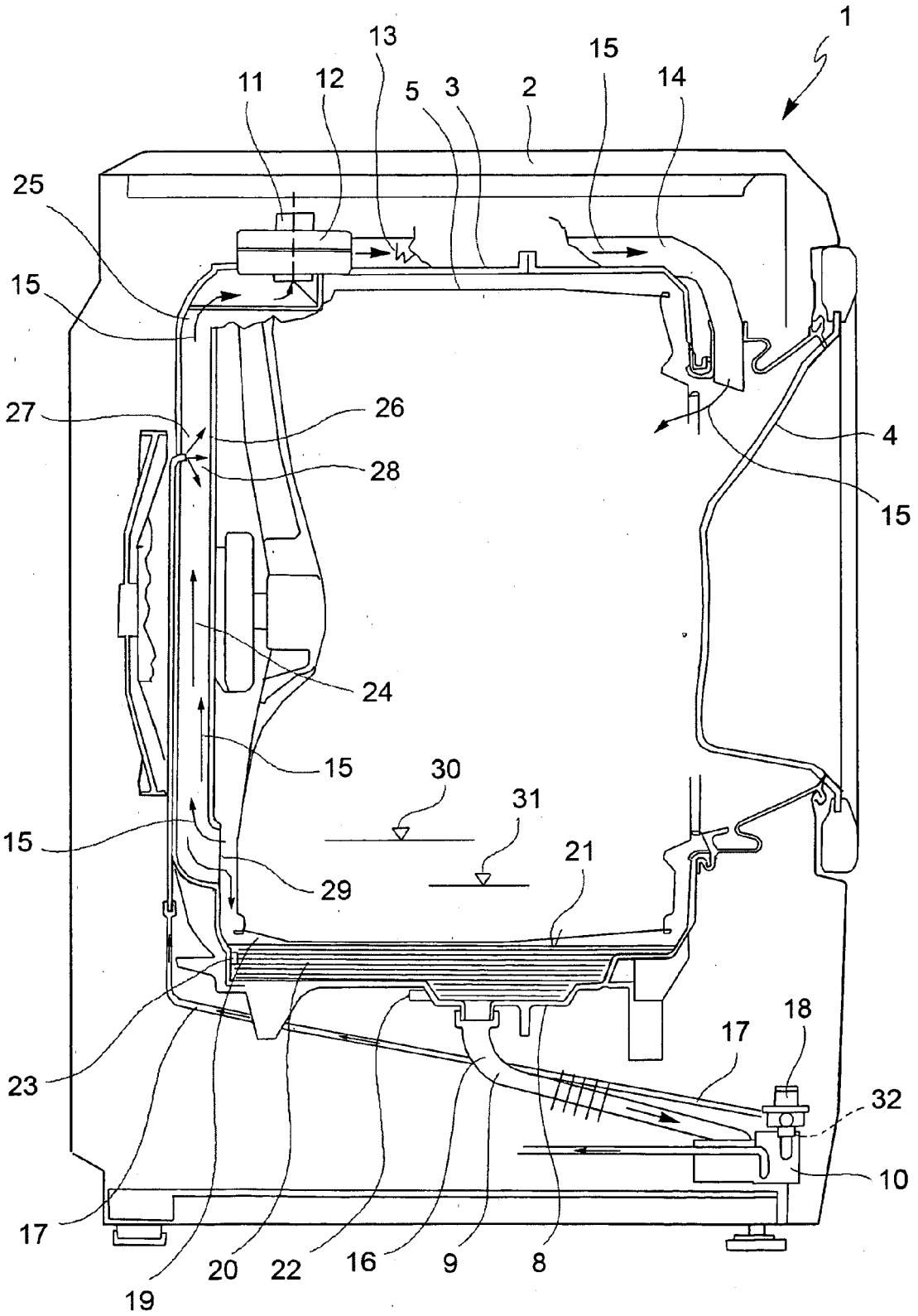
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FIG. 1

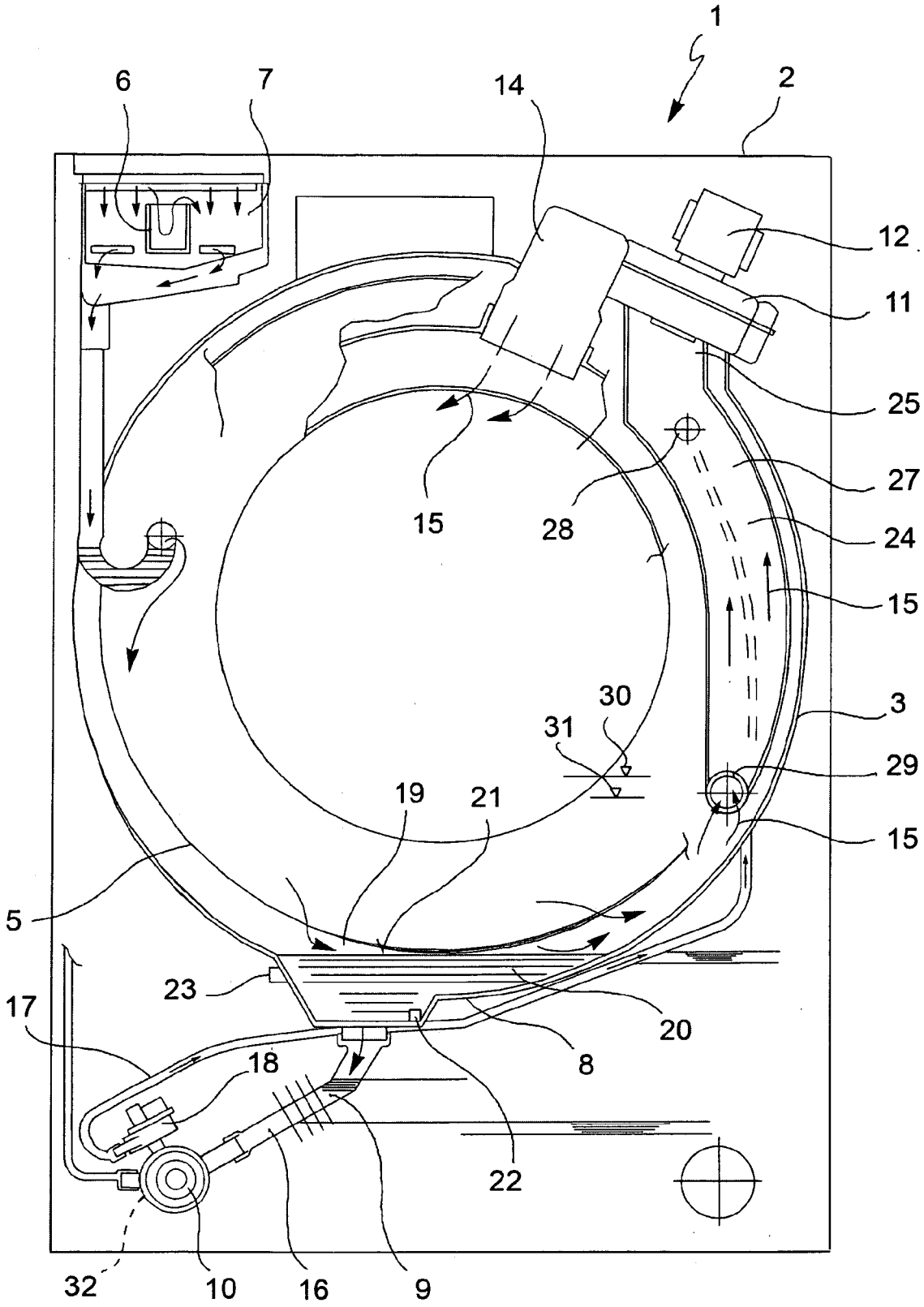
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FIG. 2

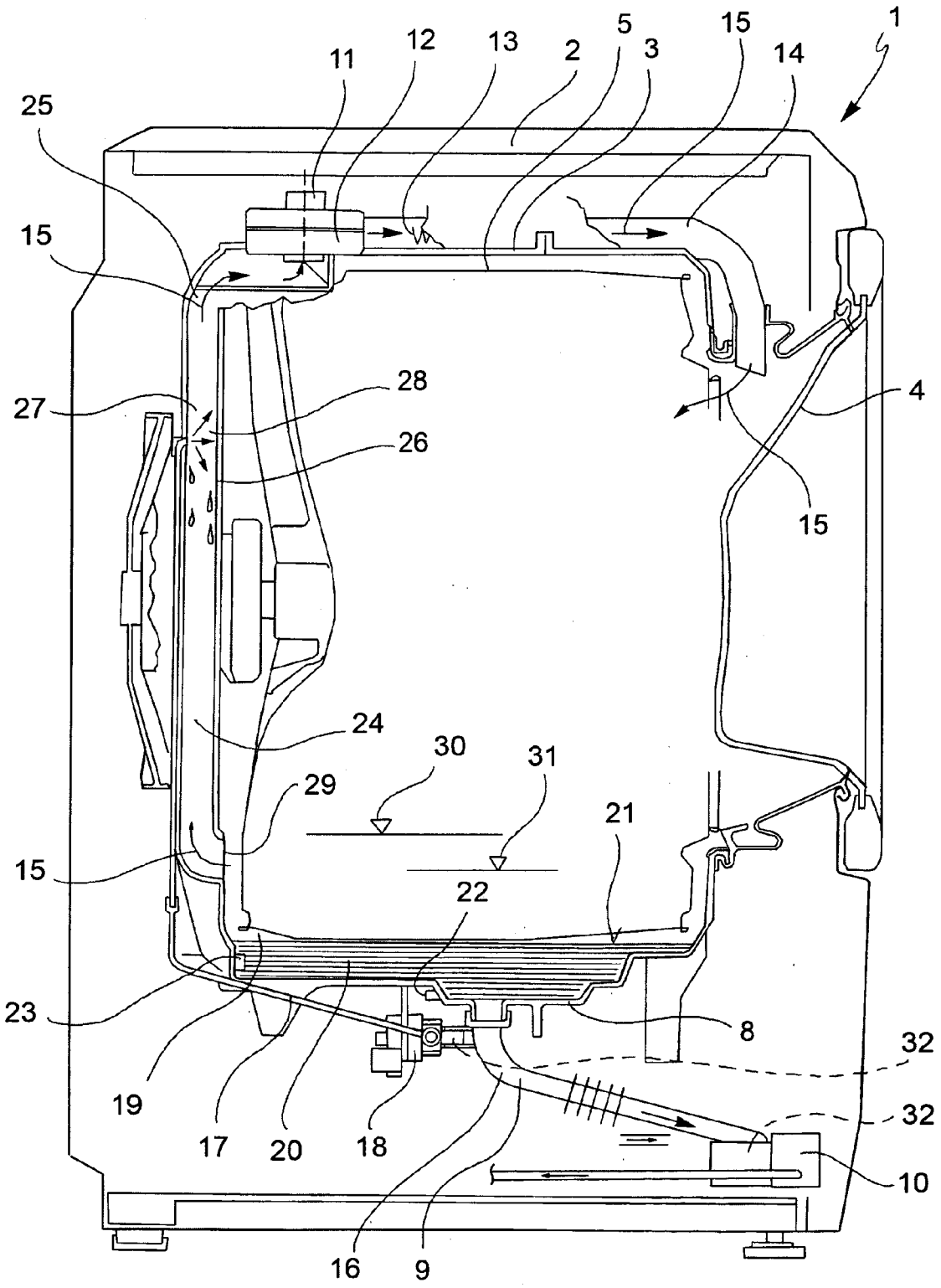
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FIG. 3

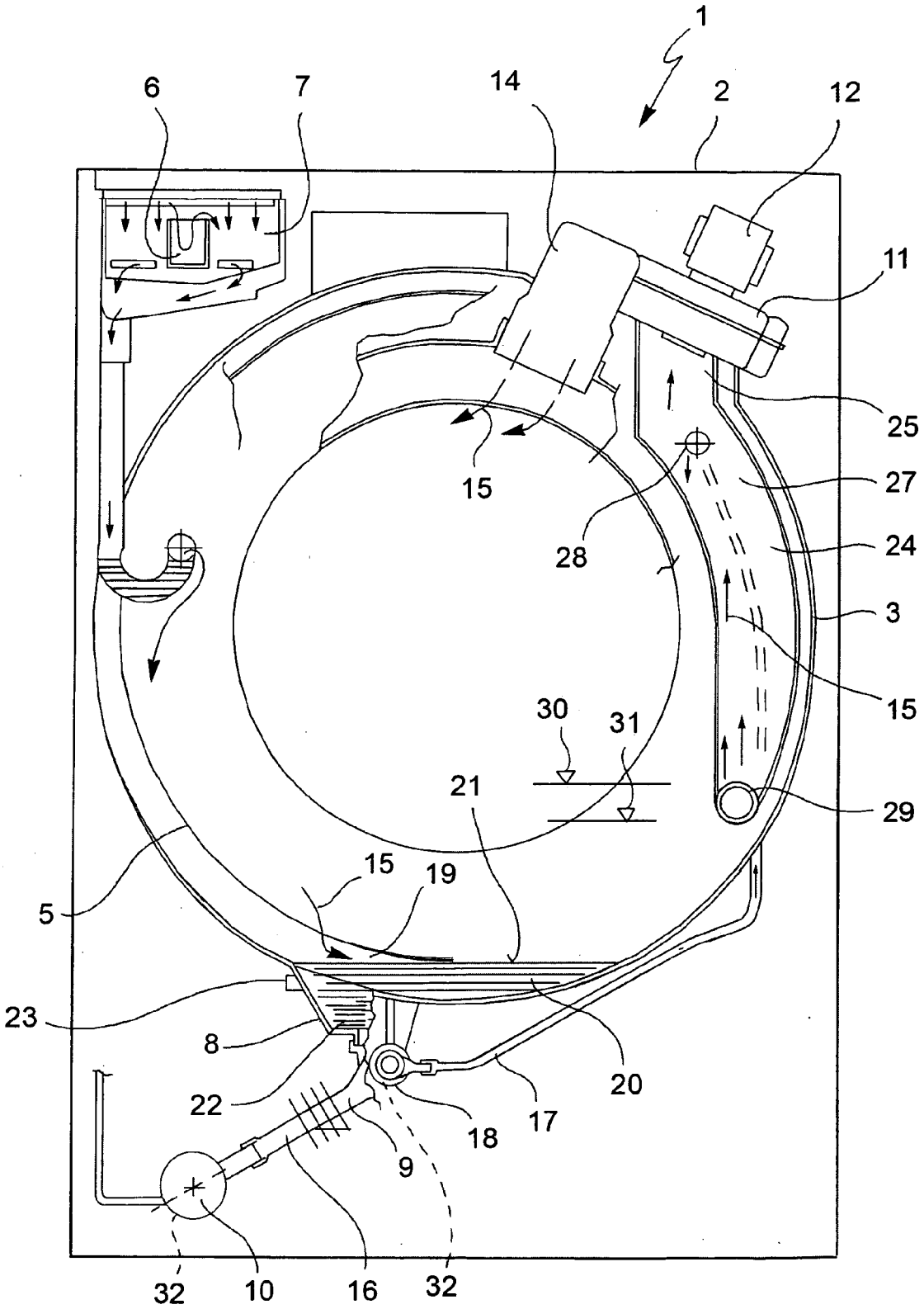
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FIG. 4

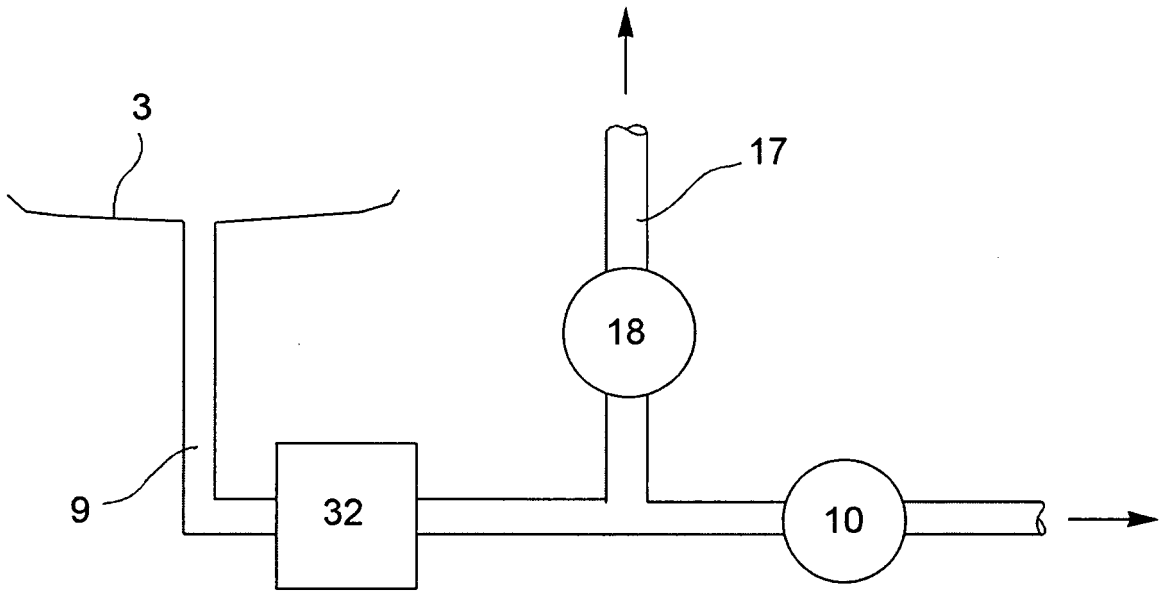

FIG. 5

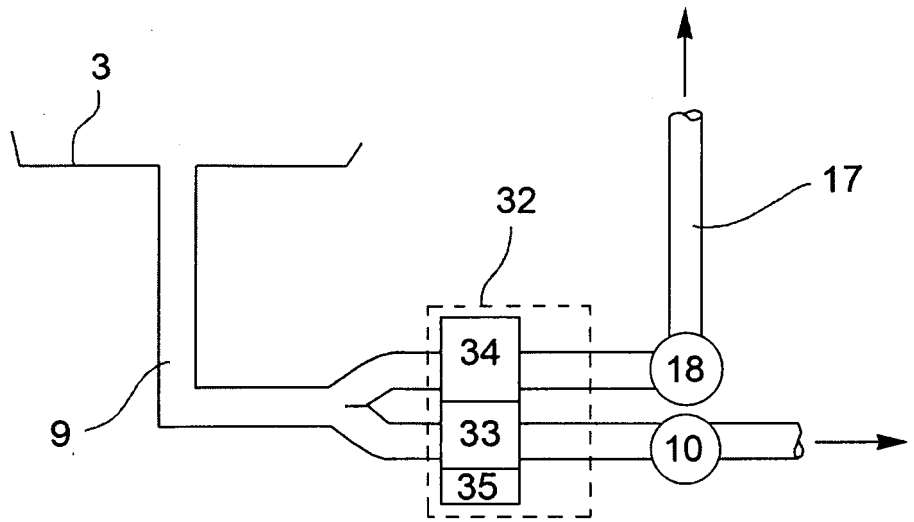

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 42 5750

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 473 403 A (SAMSUNG ELECTRONICS CO LTD [KR]) 3 November 2004 (2004-11-03) * paragraph [0020]; figure 2 *	1	INV. D06F58/24
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TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 June 2008	Stroppa, Giovanni

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