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(72) Inventors:

- **EKER, ANDAC
34445 ISTANBUL (TR)**
- **ASKIN, UFUK
34445 ISTANBUL (TR)**
- **OZBEK, HALE
34445 ISTANBUL (TR)**
- **BAYRAM, ENES
34445 ISTANBUL (TR)**
- **CULCULOGLU, TAYLAN
34445 ISTANBUL (TR)**

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(71) Applicant: **Arçelik Anonim Sirketi
34445 Istanbul (TR)**

(54) **A WASHING MACHINE COMPRISING A WATER SOFTENING UNIT**

(57) The present invention relates to a washing machine (1) comprising a tub (2) which is suitable for performing the washing process therein; a water receptacle (3) which is connected to the water inlet (20) through which the mains water is supplied via a water inlet line (21); a water softening unit (4) which is suitable for receiving a water softening member which reduces the hardness of the washing water to be used in the washing process; a water softening line (5) which extends between the water softening unit (4) and the water receptacle (3) and which enables the water in the water receptacle (3) to be delivered to the water softening unit (4); a

soft water line (6) which provides that the washing water with reduced hardness after passing through the water softening unit (4) reaches the tub (2); a salt box (8) which is connected to the water softening unit (4) by means of a regeneration line (7) and which is suitable for receiving the salt used in the regeneration of the water softening member; a water delivery line (9) which extends between the water receptacle (3) and the salt box (8) and which enables the water in the water receptacle (3) to be delivered into the salt box (8); and a control unit (10) which controls the washing process.

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Description

[0001] The present invention relates to a washing machine which comprises a water softening unit. In washing machines, water softening units are used for decreasing the hardness of the washing water and for providing an effective washing. The water softening unit comprises a water softening member which enables the hardness of the water to be removed. The hardness of the mains water passed through the water softening unit is reduced, which is then transferred to the tub to be used in the washing process. The ion retaining feature of the water softening member in the water softening unit decreases over time. The regeneration of the water softening member is performed by means of brine. Generally, in washing machines with a water softening unit, there is a salt box which is connected to the water softening unit by means of a regeneration line and which contains the salt used to regenerate the resin in the water softening unit by being soaked in brine. The regeneration process cannot be performed efficiently in the state of the art washing machines with a water softening unit.

[0002] In the state of the art Patent Application Document No. WO2018103962 (A1), a washing machine comprising a water softening unit is disclosed.

[0003] The aim of the present invention is the realization of a washing machine wherein the regeneration of the water softening member provided in the water softening unit is efficiently performed.

[0004] The washing machine of the present invention comprises a tub which is suitable for performing the washing process therein; a water receptacle which is connected to the water inlet through which the mains water is supplied via a water inlet line; a water softening unit which is suitable for receiving a water softening member which reduces the hardness of the washing water to be used in the washing process; a water softening line which extends between the water softening unit and the water receptacle and which enables the water in the water receptacle to be delivered to the water softening unit; a soft water line which ensures that the washing water with reduced hardness after passing through the water softening unit reaches the tub; a salt box which is connected to the water softening unit by means of a regeneration line and which is suitable for receiving the salt used in the regeneration of the water softening member; a water delivery line which extends between the water receptacle and the salt box and which enables the water in the water receptacle to be delivered into the salt box; and a control unit which controls the washing process. The water softening member can be resin. The resin in the water softening unit enables the magnesium and calcium ions in the water to be retained, thus reducing the hardness of the water. The ions in the water are collected on the resin. Upon reaching the total ion holding capacity thereof, the resin can be renewed so as to perform the water softening function again with the regeneration process performed. The regeneration process is carried

out by means of the salt in the salt box. The washing machine of the present invention further comprises a control unit which ensures that the brine solution obtained as a result of delivering the water from the water receptacle into the salt box through the water delivery line is delivered to the water softening unit through the regeneration line and that said brine solution is kept in the water softening unit for a predetermined period of time. Said predetermined period of time is determined by the manufacturer. As the waiting time of the brine solution in the water softening unit increases, the ability of the water softening member to reduce water hardness increases. In a version of the present invention, when the brine solution is transferred to the water softening unit through the regeneration line, the softened washing water in the water softening unit is discharged from the water softening unit. Thus, the regeneration process is enabled to be performed efficiently by preventing the salt concentration of the brine solution in the water softening unit from decreasing.

[0005] In an embodiment of the present invention, the control unit ensures that the brine solution is kept in the water softening unit for at least 10 minutes. In a preferred version of the present invention, the brine solution is kept in the water softening unit for 15 minutes. Thus, the ability of the water softening member to reduce water hardness is efficiently restored to the water softening member efficiently.

[0006] In an embodiment of the present invention, the washing machine comprises a discharge receptacle. The discharge receptacle is connected to the water softening unit through a first waste water line. The control unit enables the brine in the water softening unit to be transferred into the discharge receptacle through the first waste water line. The discharge receptacle is connected to a discharge outlet which opens to the outside of the washing machine through a discharge line. Thus, the water in the discharge receptacle is enabled to be discharged.

[0007] In an embodiment of the present invention, the control unit ensures that clean water is passed over the water softening unit through the water softening line after the brine sent into the water softening unit is discharged. Thus, the salt remaining on the resin in the water softening unit is cleaned. In other words, the resin is cleansed of salt thereon by being washed with clean water. Thus, the capacity of the resin to reduce water hardness is increased. The control unit further ensures that said water is later transferred to the discharge receptacle through the first waste water line. Thus, the brine is prevented from being delivered to the drum and from damaging the laundry. In a preferred version of the present invention, the second waste water line is connected to the upper half of the side wall of the salt box. Thus, when the user fills the salt box with salt, the water in the salt box rises upwards and can be transferred to the discharge receptacle through the second waste water line.

[0008] In an embodiment of the present invention, the

discharge receptacle is connected to the salt box through a second waste water line. The water which is present in the salt box and not used in the regeneration process is transferred to the discharge receptacle through the second waste water line. In a preferred version of the present invention, upon deciding that the regeneration process is ended, the control unit enables the water in the salt box to be transferred to the discharge receptacle. Thus, the water is prevented from being kept in the salt box for a long time. By transferring the brine to the discharge receptacle, the mixing of the brine with the water used in the washing process is prevented.

[0009] In an embodiment of the present invention, the control unit enables the water in the discharge receptacle to be mixed with the washing water in the tub and transferred to the discharge outlet. Thus, the water in the discharge receptacle is discharged with reduced salt density. Thus, salt-induced clogging in the drain pipes to which the washing machine is connected is prevented.

[0010] In an embodiment of the present invention, the washing machine comprises a first receptacle outlet which is connected to the water softening line and which is provided in the upper half of the water receptacle extending in a vertical direction with respect to the vertical direction. The water receptacle is positioned higher than the location of the water softening unit and the salt box in the washing machine body relative to the vertical direction. Thus, water can be sent from the water receptacle to the water softening unit or into the salt box by means of gravity. In a preferred version of the present invention, the water is taken into the water receptacle so as not to exceed the position of the first receptacle outlet.

[0011] In an embodiment of the present invention, the washing machine comprises a second receptacle outlet which is connected to the water delivery line and which is provided in the lower half of the water receptacle with respect to the vertical direction. After enough water is sent to the water softening unit, the water intake into the water receptacle is stopped. The volume remaining between the first receptacle outlet and the second receptacle outlet is equal to the volume of water to be passed through the salt box in the regeneration process of the water softening member. Thus, the amount of water to be passed over the salt box is correctly adjusted without the need for any sensors.

[0012] The washing machine realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 - is the perspective view of the components of the washing machine related to an embodiment of the present invention.

Figure 2 - is the schematic view of the washing machine related to an embodiment of the present invention.

Figure 3 - is the perspective view of the water receptacle of the washing machine related to an embodiment of the present invention.

Figure 4 - is the perspective view of the discharge receptacle of the washing machine related to an embodiment of the present invention.

[0013] The elements illustrated in the figures are numbered as follows:

1. Washing machine
2. Tub
3. Water receptacle
31. First receptacle outlet
32. Second receptacle outlet
4. Water softening unit
5. Water softening line
6. Soft water line
7. Regeneration line
8. Salt box
9. Delivery line
10. Control unit
11. First waste water line
12. Discharge receptacle
13. Discharge line
14. Second waste water line
15. Detergent dispenser
16. Discharge outlet
20. Water inlet
21. Water inlet line
- Y. Vertical direction

[0014] The washing machine (1) comprises a tub (2) which is suitable for performing the washing process therein; a water receptacle (3) which is connected to the water inlet (20) through which the mains water is supplied via a water inlet line (21); a water softening unit (4) which is suitable for receiving a water softening member which reduces the hardness of the washing water to be used in the washing process; a water softening line (5) which extends between the water softening unit (4) and the water receptacle (3) and which enables the water in the water receptacle (3) to be delivered to the water softening unit (4); a soft water line (6) which provides that the washing water with reduced hardness after passing through the water softening unit (4) reaches the tub (2); a salt box (8) which is connected to the water softening unit (4) by means of a regeneration line (7) and which is suitable for receiving the salt used in the regeneration of the water softening member; a water delivery line (9) which extends between the water receptacle (3) and the salt box (8) and which enables the water in the water receptacle (3) to be delivered into the salt box (8); and a control unit (10) which controls the washing process. The water receptacle (3) can be a receptacle or a water hose which allows water to pass through. The control unit (10) directs the water taken into the washing machine (1) by controlling the valves (not shown in the figures) or pumps (not shown in the figures) on the lines. The washing water delivered

to the tub (2) is passed through the water softening unit (4) and transferred to the detergent dispenser (15). The washing water is then transferred from the detergent dispenser (15) to the tub (2). Thus, the hardness level of the washing water to be delivered into the tub (2) is reduced. Consequently, the stain removal performance of the washing water is increased. Moreover, an energy-saving washing machine (1) is realized since the same stain removal performance can be achieved with less water and detergent usage.

[0015] The washing machine of the present invention further (1) comprises a control unit (10) which ensures that the brine solution obtained as a result of delivering the water from the water receptacle (3) into the salt box (8) through the water delivery line (9) is delivered to the water softening unit (4) through the regeneration line (7) and that said brine solution is kept in the water softening unit (4) for a predetermined period of time. Thus, the regeneration of the water softening member is performed efficiently. The brine solution provides that the ions on the water softening member pass into the brine, allowing the water softening member to gain the ability to reduce the water hardness again. The brine solution formed by delivering the water into the salt box (8) is transferred to the water softening unit (4) through the regeneration line (7). In order to ensure that said brine solution is kept in the water softening unit (4), the control unit (10) does not allow water to leave the water softening unit (4) for a predetermined period of time.

[0016] Thus, the regeneration of the water softening member is performed efficiently.

[0017] In an embodiment of the present invention the washing machine (1) comprises the control unit (10) which ensures that the brine solution is kept in the water softening unit (4) for at least 10 minutes. When the brine solution is kept in the water softening unit (4) for less than 10 minutes, the regeneration of the water softening member cannot be performed efficiently. By keeping the brine solution in the water softening unit (4) for at least 10 minutes, the regeneration of the water softening member is enabled to be performed efficiently.

[0018] In an embodiment of the present invention, the washing machine (1) comprises a discharge receptacle (12) which is connected to a discharge outlet (16) through a discharge line (13), which is connected to the water softening unit (4) through a first waste water line (11) and which is suitable for receiving the brine in the water softening unit (4). The discharge outlet (16) is the outlet through which the water in the washing machine (1) is transferred to the outside. The control unit (10) provides that the brine sent into the water softening unit (4) during the regeneration process is transferred to the discharge receptacle (12) after the regeneration process is completed. It is decided that the regeneration process is completed after the brine solution is kept in the water softening unit (4) for a time predetermined by the manufacturer. Thus, the brine is prevented from mixing into the washing process due being sent to the tub (2), Consequently, said

brine is prevented from damaging the laundry. The brine in the discharge receptacle (12) is then discharged from the washing machine (1) through the discharge line (13).

[0019] In an embodiment of the present invention, the washing machine (1) comprises the control unit (10) which ensures that after the brine delivered into the water softening unit (4) is discharged, clean water is passed over the water softening unit (4) through the water softening line (5) and said water is then delivered to the discharge receptacle (12) through the first waste water line (11). After the regeneration process is performed with the brine in the water softening unit (4), the brine in the water softening unit (4) is discharged. Even if the brine is discharged, some salt remains on the water softening member disposed in the water softening unit (4). In order to prevent said salt from mixing with the washing water or being delivered to the tub (2), the clean mains water is passed over the water softening member. Thus, the water softening member is washed. The clean water passed over the water softening member dissolves the salt in the water softening member and forms a brine solution with low salt concentration. The control unit (10) ensures that the resulting brine solution is transferred to the discharge receptacle (12) so as to prevent the same from mixing with the washing water. Consequently, the water softening member in the water softening unit (4) is enabled to become ready for the water softening process in the next washing cycle.

[0020] In an embodiment of the present invention, the washing machine (1) comprises the discharge receptacle (12) which is connected to the salt box (8) through a second waste water line (14) and which is suitable for receiving the brine in the salt box (8). Most of the brine in the salt box (8) is sent to the water softening unit (4) for the regeneration process. The water remaining in the salt box (8) is transferred to the discharge receptacle (12) by the control unit (10) through the second waste water line (14). In a preferred version of the present invention, the brine remaining in the salt box (8) at the end of the washing process is transferred to the discharge receptacle (12). Thus, it is provided that no water is left in the salt box (8) at the end of the washing process, and the salt is prevented from getting spoiled.

[0021] In an embodiment of the present invention, the washing machine (1) comprises the control unit (10) which enables the water in the discharge receptacle (12) to be mixed with the washing water in the tub (2) and transferred to the discharge outlet (16). Thus, salt concentration is reduced by mixing the brine in the discharge receptacle (12) with the washing water. Thus, the brine with high salt concentration in the discharge receptacle (12) is prevented from corroding the drain pipes to which the discharge outlet (16) is connected. In an embodiment of the present invention, the washing machine (1) comprises a first receptacle outlet (31) which is connected to the water softening line (5) and which is provided in the upper half of the water receptacle (3) extending in a vertical direction (Y) with respect to the vertical direction (Y).

The water receptacle (3) extends in a vertical direction (Y) in the body of the washing machine (1). The vertical direction (Y) is a direction parallel to the height direction of the washing machine (1). The first receptacle outlet (31) is positioned in the upper half of the water receptacle (3). Thus, after the water receptacle (31) is filled up to the first receptacle outlet (31), water is discharged through the first receptacle outlet (31). Consequently, after water is sent to the water softening unit (4) from the first receptacle outlet (31) through the water softening line (5), some water is enabled to be remain stored in the water receptacle (3).

[0022] In an embodiment of the present invention, the washing machine (1) comprises a second receptacle outlet (32) which is connected to the water delivery line (9) and which is provided in the lower half of the water receptacle (3) with respect to the vertical direction (Y). The second receptacle outlet (32) remains below the first receptacle outlet (31) relative to the vertical direction (Y). In a preferred version of the present invention, after sufficient water is sent from the first receptacle outlet (31) to the water softening unit (4), the water intake through the water inlet (20) into the washing machine (1) is stopped. The water required for the regeneration process is supplied from the water remaining in the water receptacle (3). Thus, it is provided that the required water is supplied in the right amount during the regeneration process.

[0023] By means of the present invention, a washing machine (1) is realized, wherein the regeneration of the water softening member provided in the water softening unit (4) is efficiently performed.

Claims

1. A washing machine (1) **comprising** a tub (2) which is suitable for performing the washing process therein; a water receptacle (3) which is connected to the water inlet (20) through which the mains water is supplied via a water inlet line (21); a water softening unit (4) which is suitable for receiving a water softening member which reduces the hardness of the washing water to be used in the washing process; a water softening line (5) which extends between the water softening unit (4) and the water receptacle (3) and which enables the water in the water receptacle (3) to be delivered to the water softening unit (4); a soft water line (6) which provides that the washing water with reduced hardness after passing through the water softening unit (4) reaches the tub (2); a salt box (8) which is connected to the water softening unit (4) by means of a regeneration line (7) and which is suitable for receiving the salt used in the regeneration of the water softening member; a water delivery line (9) which extends between the water receptacle (3) and the salt box (8) and which enables the water in the water receptacle (3) to be delivered into the

salt box (8); and a control unit (10) which controls the washing process,

- **characterized by** the control unit (10) which ensures that the brine solution obtained as a result of delivering the water from the water receptacle (3) into the salt box (8) through the water delivery line (9) is delivered to the water softening unit (4) through the regeneration line (7) and that said brine solution is kept in the water softening unit (4) for a predetermined period of time.

2. A washing machine (1) as in Claim 1, **characterized by** the control unit (10) which ensures that the brine solution is kept in the water softening unit (4) for at least 10 minutes.

3. A washing machine (1) as in Claim 1 or 2, **characterized by** a discharge receptacle (12) which is connected to a discharge outlet (16) through a discharge line (13), which is connected to the water softening unit (4) through a first waste water line (11) and which is suitable for receiving the brine in the water softening unit (4).

4. A washing machine (1) as in Claim 3, **characterized by** the control unit (10) which ensures that after the brine delivered into the water softening unit (4) is discharged, clean water is passed over the water softening unit (4) through the water softening line (5) and said water is then delivered to the discharge receptacle (12) through the first waste water line (11).

5. A washing machine (1) as in Claim 3 or 4, **characterized by** the discharge receptacle (12) which is connected to the salt box (8) through a second waste water line (14) and which is suitable for receiving the brine in the salt box (8).

6. A washing machine (1) as in any one of Claims 3 to 5, **characterized by** the control unit (10) which enables the water in the discharge receptacle (12) to be mixed with the washing water in the tub (2) and transferred to the discharge outlet (16).

7. A washing machine (1) as in any one of the above claims, **characterized by** a first receptacle outlet (31) which is connected to the water softening line (5) and which is provided in the upper half of the water receptacle (3) extending in a vertical direction (Y) with respect to the vertical direction (Y).

8. A washing machine (1) as in any one of the above claims, **characterized by** a second receptacle outlet (32) which is connected to the water delivery line (9) and which is provided in the lower half of the water receptacle (3) with respect to the vertical direction (Y).

Figure 1

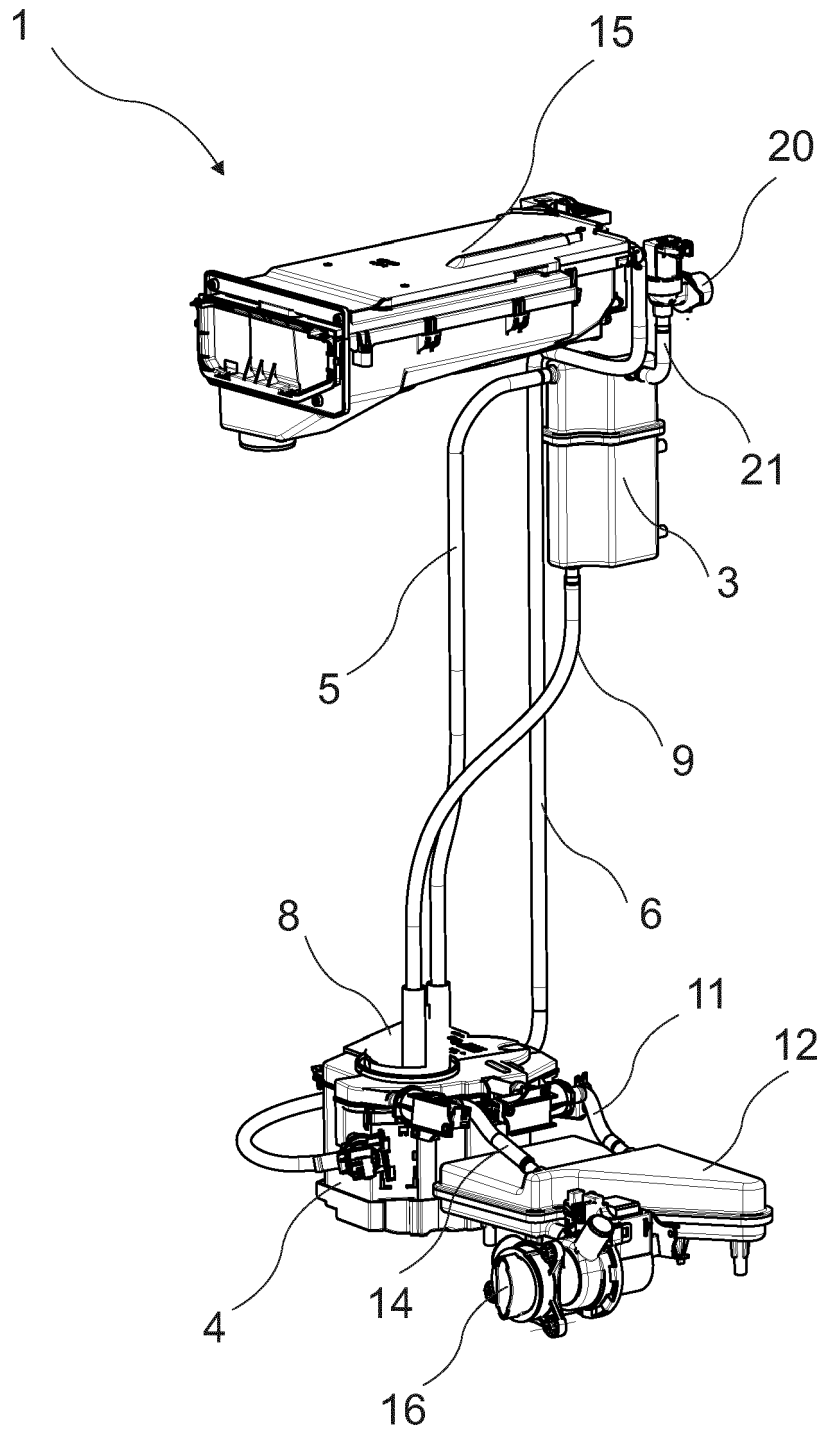


Figure 2

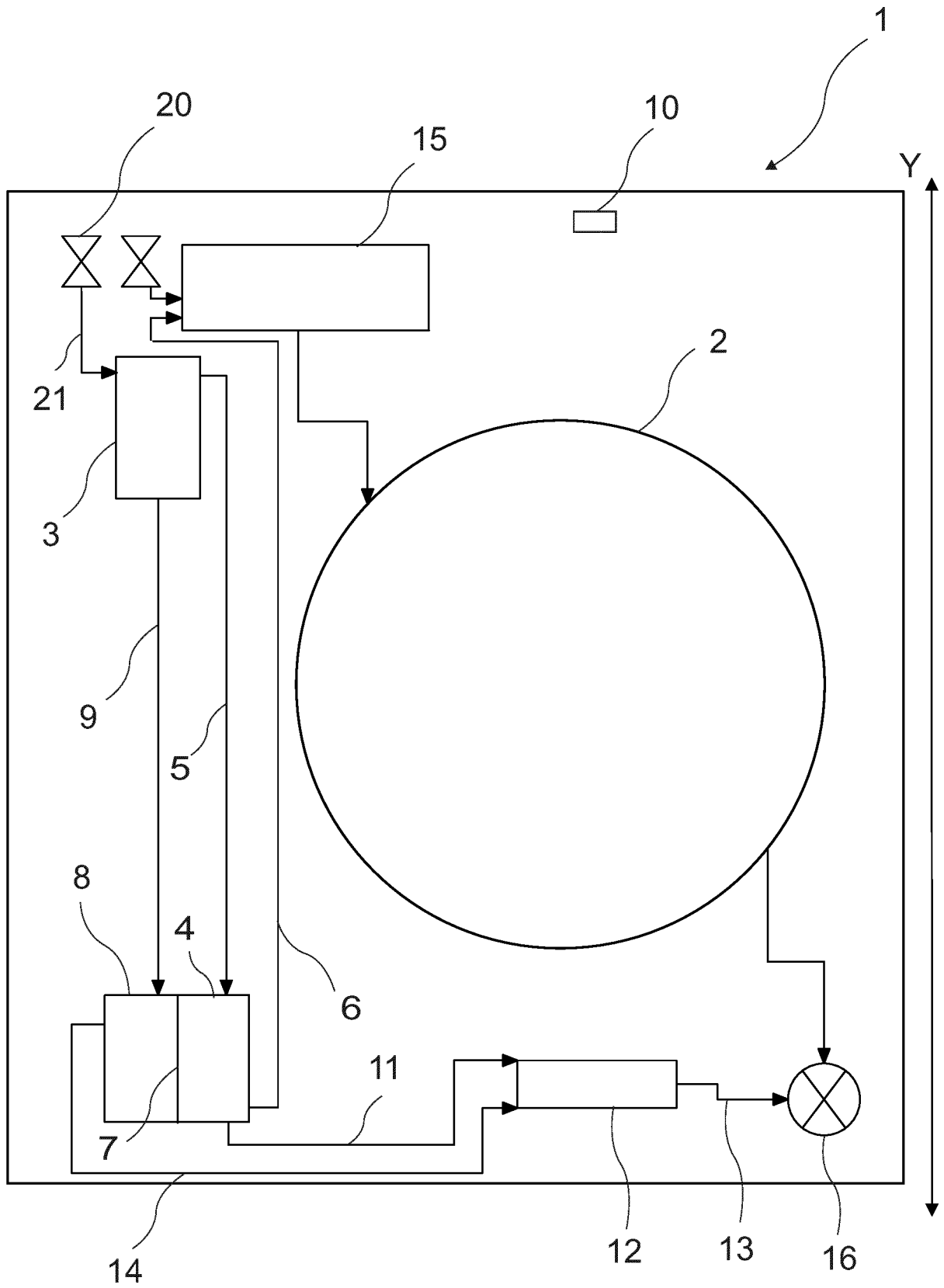


Figure 3

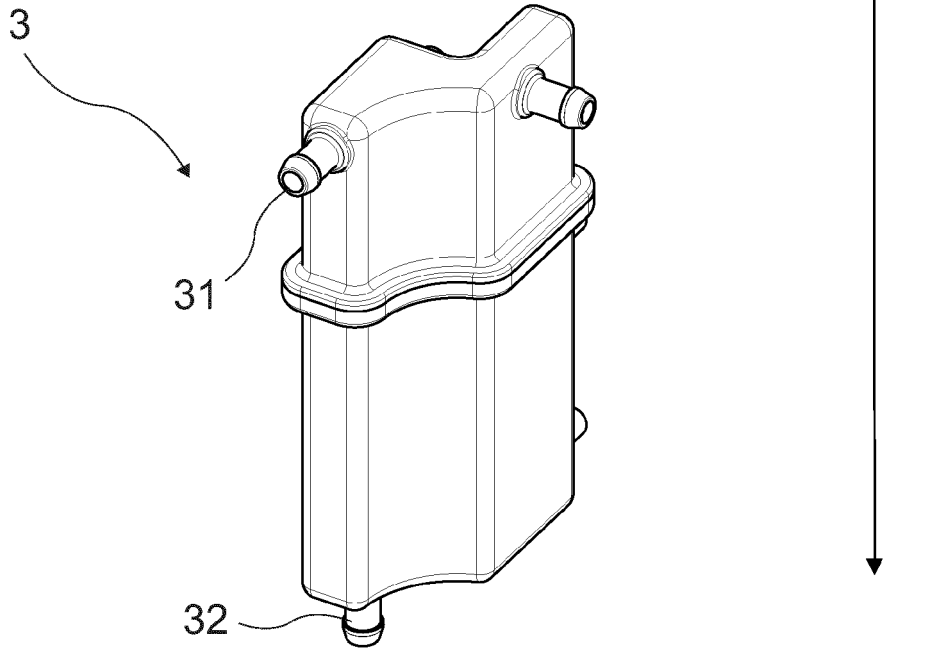
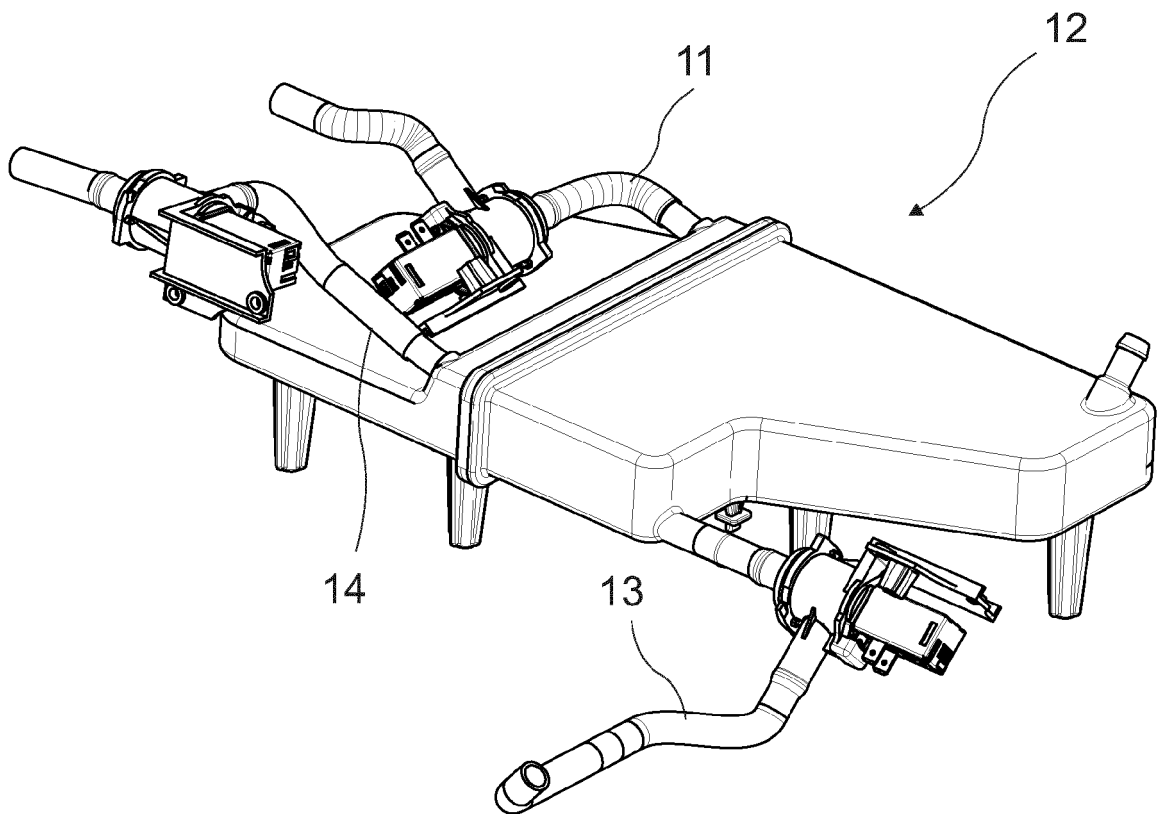


Figure 4





EUROPEAN SEARCH REPORT

Application Number
EP 23 22 0159

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Place of search Munich		Date of completion of the search 2 May 2024	Examiner Popara, Velimir
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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