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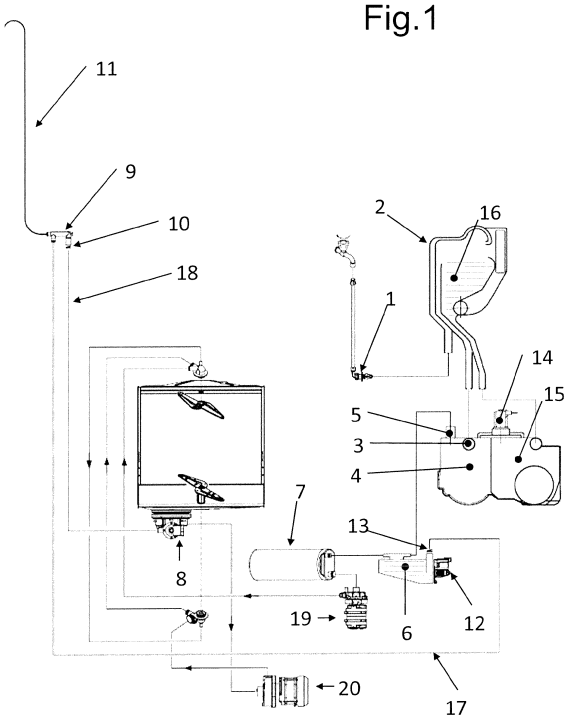
(54) INDUSTRIAL DISHWASHER WITH IMPROVED WATER SOFTENING CIRCUIT AND RELEVANT OPERATING METHOD

(57) An industrial dishwasher includes a mains water load valve (1), a water softener (4) with decalcifying resins, a salt container (15) that receives mains water to form a brine solution that then reaches the softener (4) through a regeneration valve (14), a heater (7) receiving water decalcified by the softener (4), an exchange container (6) arranged between the softener (4) and the heater (7), an evacuation pump (12) connected to the exchange container (6) in such a way as to completely empty it, and a bypass duct (17) connecting the evacuation pump (12) to a drain (11). With this configuration it is possible to regenerate the resins simultaneously with one or more wash cycles, without having to resort to waiting times or complex duplicate water treatment circuits, so that the regeneration is carried out only when necessary and without significantly affecting the exploitation of the machine.

Fig.1



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Description

[0001] The present invention concerns industrial dishwashers, and in particular a dishwasher with an improved water softening circuit and a relative operating method.

[0002] It is known that industrial dishwashers used in professional sectors (restaurants, bars, etc.) are generally characterized by very simple load and wash circuits, both because they must guarantee the maximum possible reliability, since they are working tools, and because there are no internationally recognized standards requiring compliance with particular performance constraints. These circuits differ from those of domestic dishwashers in various respects, in particular in the presence of two separate wash and rinse circuits, each with its own sprinklers.

[0003] In other words, the wash water is sprayed onto the dishes by a wash pump and during rinsing a part of this water is replaced by rinse water pre-heated in a heater and fed to the rinse circuit by a suitable rinse pump. More specifically, if said machines are provided with a built-in water softening circuit, the water coming from the mains passes through the softener and arrives at the heater, from where it is fed to the wash tank.

[0004] An aspect in common with domestic dishwashers is the water softening process carried out by means of decalcifying resins that remove the calcium and magnesium salts contained in the water. These resins must be periodically regenerated by means of a brine, and the regeneration phase of the resins requires a minimum time of at least 6-7 minutes for the brine to be combined by ion exchange with the calcium and magnesium salts present on the resins, thus removing them.

[0005] However, this is only the time required for the chemical reaction in the softener while the overall time for regeneration is longer. In fact, we must also consider the subsequent emptying of the softener and the complete replacement of the water therein to wash away the brine from the resins, so as to prevent the arrival of salt water to the tank when the softener resumes its function.

[0006] Considering that the duration of a wash cycle of an industrial dishwasher is of the order of 2-4 minutes, routine operations like this which involve a machine stop of more than 5-10 minutes are unacceptable if you want to obtain an adequate exploitation of the machine. Consequently, these operations are carried out during the periods of pause in the use of the machine, but these periods very rarely coincide, depending on the number of wash cycles carried out and therefore the litres of decalcified water, with the moment of the actual need for resin regeneration.

[0007] As a result, the machine may be forced to operate with resins already completely "exhausted", possibly for several cycles, or vice versa, it may be forced to regenerate resins that are still able to treat a lot of water. In the first case it is clear that the water is not decalcified so the expected wash results are not achieved and calcium and magnesium salts can damage the machine, while in the second case there is a waste of water and salt.

[0008] In order to avoid this inconvenience and to avoid breaks in operation, there are also models of industrial dishwashers that are provided with water treatment devices including two softeners mounted in parallel and connected to the hydraulic circuit of the machine through a plurality of ducts controlled by valves. In this way, when the time comes to regenerate the resins of a first softener currently in operation, the task of treating the water is transferred to the second softener, and the machine can continue to operate while the regeneration of the resins is carried out in the first softener.

[0009] More specifically, a first diverter valve is located upstream of the two softeners to direct the incoming water from the mains to the softener that has to treat the water, while the salt tank is connected to both softeners by two regeneration valves that are opened alternately depending on which resins have to be regenerated. Moreover, the outlets of the two softeners converge upstream of a second diverter valve that directs the water towards the heater, during the normal operation of the softener, or towards the drain during the phase of washing away the brine from the resins.

[0010] The presence of these additional valves and ducts implies a clear constructive complication and has a considerable impact on the costs, such a circuit also placing constraints in the arrangement of adjacent components such as, for example, the heater. Moreover, the execution of one or more wash cycles during the resin regeneration phase is only possible with certain limits, since during the above phase of washing away the brine from the resins the second diverter valve must be switched towards the drain, with the consequence that the softener currently in operation cannot supply the heater during this phase.

[0011] From the above it is easy to understand that, although it is possible to carry out a wash cycle simultaneously with the resin regeneration phase, at the time of the brine and resins wash water discharge there is an interference with the wash cycle. It would be possible to avoid such an interference by connecting each softener directly with the heater and the drain pipe through its own specific ducts that branch from its own diverter valve, but this would obviously imply a further increase in construction complexity and costs.

[0012] A further drawback of conventional dishwashers is when an "air gap" is provided between the water load valve and the rest of the dishwasher's hydraulic circuit, to meet the standards of some countries (e.g. the WRAS standard in the UK) which require a clear separation between the clean water entering from the mains and the contaminated water already present in the dishwasher. In fact, the presence of the air gap causes a strong pressure drop between the section downstream and upstream of the air gap, which places limits on the discharge capacity of the dishwasher. More specifically, if the outlet of the drain pipe is too high, for example at 100 cm instead of less than 75 cm, the discharge oper-

ation is not carried out correctly or does not even take place.

[0013] The purpose of this invention is therefore to provide an industrial dishwasher that overcomes these drawbacks. This purpose is achieved by means of an industrial dishwasher provided with an exchange container placed between the softener and the heater, this exchange container being connected directly to the drain through a heater bypass duct, and being provided with an evacuation pump. Other advantageous features of this industrial dishwasher are specified in the dependent claims.

[0014] The main advantage of the dishwasher according to the present invention is that of being able to regenerate the resins simultaneously with a wash cycle with a simpler and cheaper hydraulic circuit structure.

[0015] A further advantage of this dishwasher is that the absence of a second softener and the relative additional ducts and valves makes the hydraulic circuit smaller and allows more freedom in the arrangement of the elements that compose it.

[0016] Yet another advantage of this dishwasher, particularly when there is an air gap, is the guarantee that the discharge phase takes place regularly regardless of the height of the outlet of the drain pipe, since this phase always takes place by means of a pump, both from the sump of the wash tank and from the softener.

[0017] These and other advantages and characteristics of the industrial dishwasher according to the present invention will be evident to those skilled in the art from the following detailed description an embodiment thereof with reference to the annexed drawings in which:

Fig.1 is a schematic view that illustrates the hydraulic circuit of the dishwasher with the water circulation during the wash cycle;

Fig.2 is a view similar to the previous one showing the water circulation during the water loading in the dishwasher;

Fig.3 is a view similar to the previous one showing the water circulation during the brine loading in the softener; and

Fig.4 is a view similar to the previous one showing the water circulation during the washing away of the brine from the softener.

[0018] Referring to these figures, there is seen that an industrial dishwasher according to the present invention conventionally includes a valve 1 for loading the mains water that controls the flow from a tap to a softener 4, containing decalcifying resins, possibly passing through an air gap 2 provided with a first outlet at the bottom of a main chamber 16 and a second outlet at the bottom of an overflow pipe of said chamber 16. The water coming from this second outlet of air gap 2 enters softener 4 through an inlet 3 and comes out decalcified through an outlet 5 to reach then a heater 7, outlet 5 being preferably formed at the top of softener 4 so that the water comes out by overflowing.

[0019] During the rinse phase, a rinse pump 19 takes the heated water from heater 7 and sends it to the rinse sprinklers that spray it into the tank. Here the water is then collected in a bottom sump and used also in the following wash phases, by means of a wash pump 20 that supplies the relative wash sprinklers, while a part is discharged through a drain 11 by means of a drain pump 8 connected to the drain 11 through a drain pipe 18.

[0020] For the regeneration of the resins of softener 4 there is a salt container 15 connected thereto through a regeneration valve 14 that controls the flow of the mains water, possibly passing through the air gap 2 through its first outlet, used to form the brine that then arrives at softener 4 where it combines with the resins to clean them of calcium and magnesium salts.

[0021] A first innovative aspect of this dishwasher is the presence of an exchange container 6 placed between softener 4 and heater 7, this exchange container 6 receiving the water coming from outlet 5 of softener 4 and being in turn connected to the inlet of heater 7.

[0022] A second innovative aspect of this dishwasher is the presence of an evacuation pump 12, which is connected to the exchange container 6 in such a way as to empty it completely by draining the water contained therein through a bypass duct 17 connected to drain 11. Preferably, the evacuation pump 12 is provided with a unidirectional valve 13 and is mounted directly on the exchange container 6, the bypass duct 17 is connected to drain 11 through a fitting 9, and also the drain pipe 18 is connected to said fitting 9 through a unidirectional valve 10.

[0023] In the light of the description above, the simple and effective operation of the industrial dishwasher according to the present invention is readily understood.

[0024] During the initial preparation phase of the machine, the load valve 1 is opened so as to fill in sequence the salt container 15, the main chamber 16 of air gap 2 (valve 14 being closed), softener 4, the exchange container 6 (pump 12 being off), and heater 7 in which the water is heated to the set temperature and transferred into the tank until the correct level is reached. Once the load in the tank has been completed, heater 7 is filled again and the water contained therein is brought to the rinse temperature. When the entire circuit, including air gap 2 and the exchange container 6, is filled and the water temperatures in the wash tank and heater 7 have reached the set values, the machine indicates that it is ready and the user can start washing the dishes.

[0025] As previously mentioned, at the end of the wash phase, a predetermined quantity of water is drained from the tank by means of the drain pump 8, and the rinse phase begins which uses the water of heater 7, in which the water level must be promptly restored. To this purpose, as shown by the arrows in Fig.2, the load valve 1 is opened so that the water arrives at air gap 2, crosses it overflowing from chamber 16, enters through inlet 3 of softener 4 and, after passing through the resins, exits

decalcified from outlet 5, crossing the exchange container 6 already full and finally arriving in heater 7 filling it again (the load valve 1 is obviously closed as soon as heater 7 is full).

[0026] After a certain number of wash cycles, depending on the hardness of the mains water and the quantity of water used, the resins of softener 4 must be regenerated. When starting the regeneration phase of the resins, it is necessary to activate the evacuation pump 12 of the exchange container 6 in order to empty it completely, through the bypass duct 17 and fitting 9 that connect it to drain 11 (pump 12 is preferably deactivated when the container 6 is empty but could also remain on).

[0027] At this point, as shown by the arrows in Fig.3, the regeneration valve 14 is opened, which connects the salt container 15 with softener 4. In this way, the water in chamber 16 of air gap 2 can descend into the salt container 15 and, through valve 14, push the brine into the resins until softener 4 is filled with brine (the regeneration valve 14 is closed after chamber 16 is emptied).

[0028] After an adequate contact time between the brine and the decalcifying resins, the "resins wash" is carried out, i.e. the brine is washed away from the resins to prevent the arrival of salt water in the tank. To this purpose, as shown by the arrows in Fig.4, pump 12 is activated and the load valve 1 is opened so that the mains water, after crossing the air gap 2 upon filling chamber 16, reaches softener 4 washing the resins.

[0029] The brine and the resins wash water overflowing through outlet 5 reach the exchange container 6 but, since the evacuation pump 12 is working, they do not proceed towards heater 7 (as shown in Fig.2) and are rather discharged through the bypass duct 17 connected to fitting 9 (as shown in Fig.3).

[0030] At the end of the above operations illustrated in figures 3 and 4, which take no more than 8-10 minutes, pump 12 is deactivated and load valve 1 is closed after container 6 and softener 4 have been filled with clean, decalcified water, restoring the normal operating condition illustrated in Fig.1 with all the parts of the hydraulic circuit filled and ready for use.

[0031] From the above it is easy to understand how the dishwasher according to the present invention can perform a wash cycle that is simultaneous with and completely independent of the resin regeneration phase. In fact, while the wash pump 20 and the rinse pump 19 take the water from the sump and heater 7 respectively, the regeneration of the resins only affects softener 4 and the exchange container 6, from where pump 12 directs the brine and the resins wash water directly to drain 11 through the bypass duct 17.

[0032] It should be noted that even with an intensive use of the machine during resin regeneration (max. 2-3 washing cycles) there are no problems with the amount of water required, since heater 7 usually contains about 9 litres of decalcified water, the tank usually contains about 22 litres of decalcified water and the water consumption per cycle is usually about 3 litres.

[0033] It is clear that the above-described and illustrated embodiment of the dishwasher according to the invention is just an example susceptible to numerous variations. In particular, the exact shape and arrangement of the exchange container 6, the evacuation pump 12, the bypass duct 17 and any air gap 2 can be freely varied according to specific construction requirements, as long as their relative arrangement within the hydraulic circuit illustrated above is maintained.

[0034] In addition, the hydraulic circuit may also not include air gap 2, so that the mains water entering through the load valve 1 would reach directly softener 4 and the salt container 15 through respective ducts that branch out from a diverter valve (not shown), possibly integrated in the load valve 1 itself.

[0035] In this case, at the beginning of the regeneration phase it is necessary to open the regeneration valve 14 and the load valve 1, after the diverter valve has been switched to direct the water towards the salt container 15, so as to transfer the brine to softener 4. In addition, the evacuation pump 12 is only switched off after closing the load valve 1 or the regeneration valve 14 to ensure that any excess brine that may overflow from outlet 5 into the exchange container 6 does not pollute the water in heater 7.

[0036] For the subsequent washing of the resins, before opening the load valve 1 it is obviously necessary to switch the diverter valve so that the mains water is directed towards softener 4.

Claims

1. Industrial dishwasher including a load valve (1) that controls the flow of water from the mains, a softener (4) with decalcifying resins that receives the water from the mains to decalcify it, a salt container (15) that receives the water from the mains to form a brine solution that then reaches said softener (4) through a regeneration valve (14), means of transferring the water coming from said load valve (1) to the softener (4) or to said salt container (15), a heater (7) which receives decalcified water coming from the softener (4) and supplies rinse sprinklers by means of a rinse pump (19), and a drain pump (8) connected to a drain (11) through a drain pipe (18) so as to drain water from a bottom sump of the dishwasher wash tank, **characterized in that** it further includes an exchange container (6) located between the softener (4) and said heater (7), said exchange container (6) receiving the water coming from the softener (4) and being in turn connected to an inlet of the heater (7), an evacuation pump (12) connected to the exchange container (6) in such a way as to empty it completely, as well as a bypass duct (17) connecting said evacuation pump (12) to said drain (11).

2. Industrial dishwasher according to claim 1, **charac-**

terized in that the means of transferring the water coming from the load valve (1) to the softener (4) or to the salt container (15) consist of a diverter valve located between the load valve (1) and the rest of the hydraulic circuit or integrated in the load valve (1).

3. Industrial dishwasher according to claim 1, **characterized in that** the means of transferring the water coming from the load valve (1) to the softener (4) or to the salt container (15) consist of an air gap (2) located between the load valve (1) and the rest of the hydraulic circuit so as to ensure separation between the water entering from the mains and the water already present in the dishwasher, said air gap (2) being provided with a first outlet at the bottom of a main chamber (16) and with a second outlet at the bottom of an overflow pipe of said main chamber (16), said first outlet being connected to the salt container (15) and said second outlet being connected to the softener (4).

4. Industrial dishwasher according to any of the previous claims, **characterized in that** the bypass duct (17) is connected to the drain (11) through a fitting (9), to which is also connected the drain pipe (18) preferably through a unidirectional valve (10).

5. Industrial dishwasher according to any of the previous claims, **characterized in that** the evacuation pump (12) is mounted directly on the exchange container (6) and is provided with a unidirectional valve (13).

6. Method for the regeneration of the decalcifying resins of the softener (4) of an industrial dishwasher according to claim 2, **characterized in that** it includes the following steps:

a) activate the evacuation pump (12) and switch the diverter valve so as to connect the load valve (1) with the salt container (15);
b) open the load valve (1) and the regeneration valve (14);
c) close the load valve (1) and the regeneration valve (14) after the brine has completely filled the softener (4);
d) deactivate the evacuation pump (12);
e) wait for a suitable contact time between the brine and the decalcifying resins;
f) switch the diverter valve so as to connect the load valve (1) with the softener (4);
g) open the load valve (1) in order to wash away the brine from the resins and activate the evacuation pump (12);
h) evacuate the brine and the resins wash water through the bypass duct (17) and the drain (11);
i) deactivate the evacuation pump (12);
j) close the load valve (1) after filling the exchange container (6).

7. Method for regenerating the decalcifying resins of the softener (4) of an industrial dishwasher according to claim 3, **characterized in that** it includes the following steps:

a) activate the evacuation pump (12);
b) open the regeneration valve (14);
c) close the regeneration valve (14) after the brine has completely filled the softener (4);
d) deactivate the evacuation pump (12);
e) wait for an adequate contact time between the brine and the decalcifying resins;
f) open the load valve (1) in order to wash away the brine from the resins and activate the evacuation pump (12);
g) evacuate the brine and the resins wash water through the bypass duct (17) and the drain (11);
h) deactivate the evacuation pump (12);
i) close the load valve (1) after filling the exchange container (6).

8. Method according to claim 6 or 7, **characterized in that** the evacuation pump (12) is activated in the first phase and then deactivated only before the last phase in which the exchange tank (6) is filled.

9. Method according to any of claims 6 to 8, **characterized in that** one or more of the phases are carried out during one or more wash cycles.

Fig.1

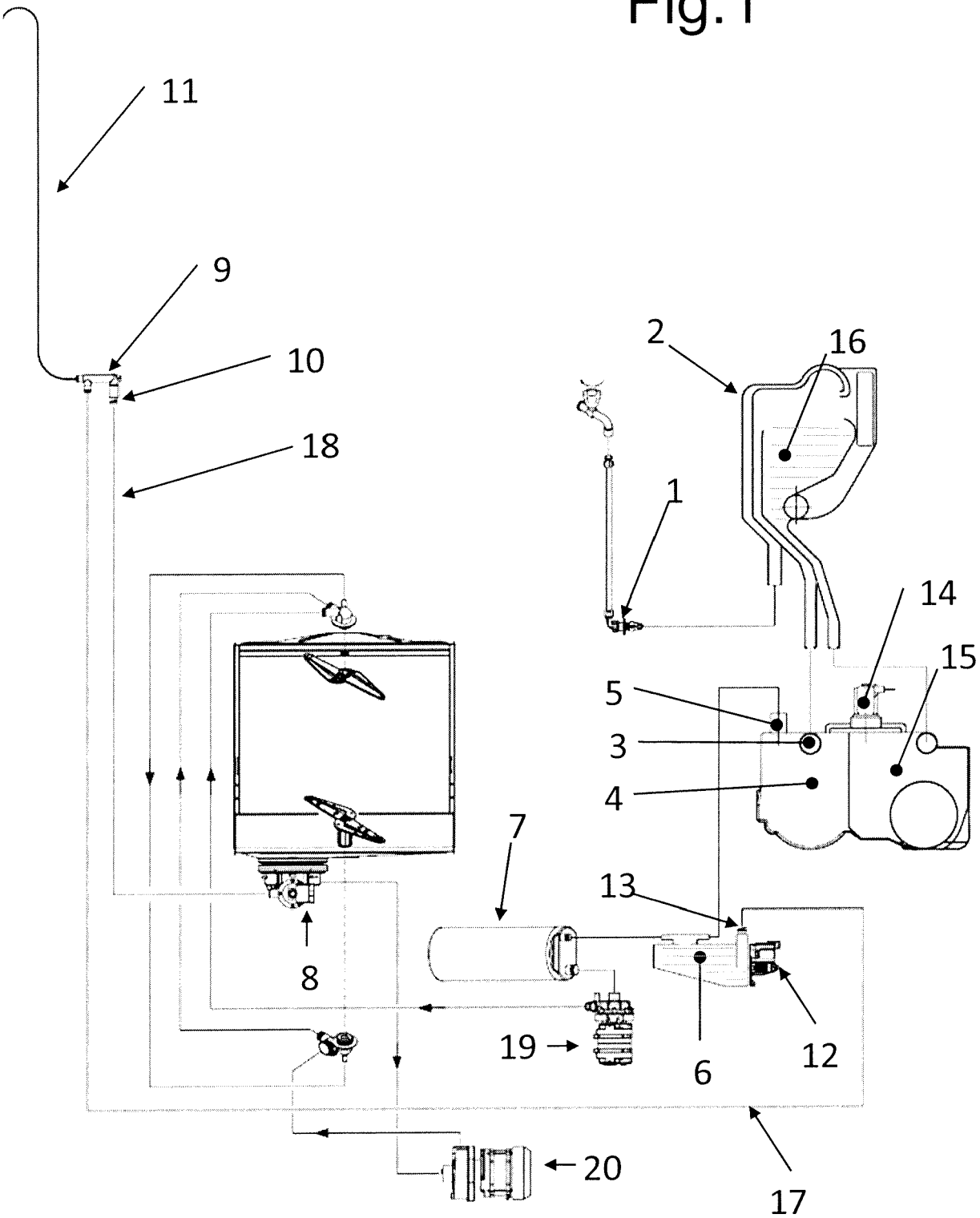


Fig.2

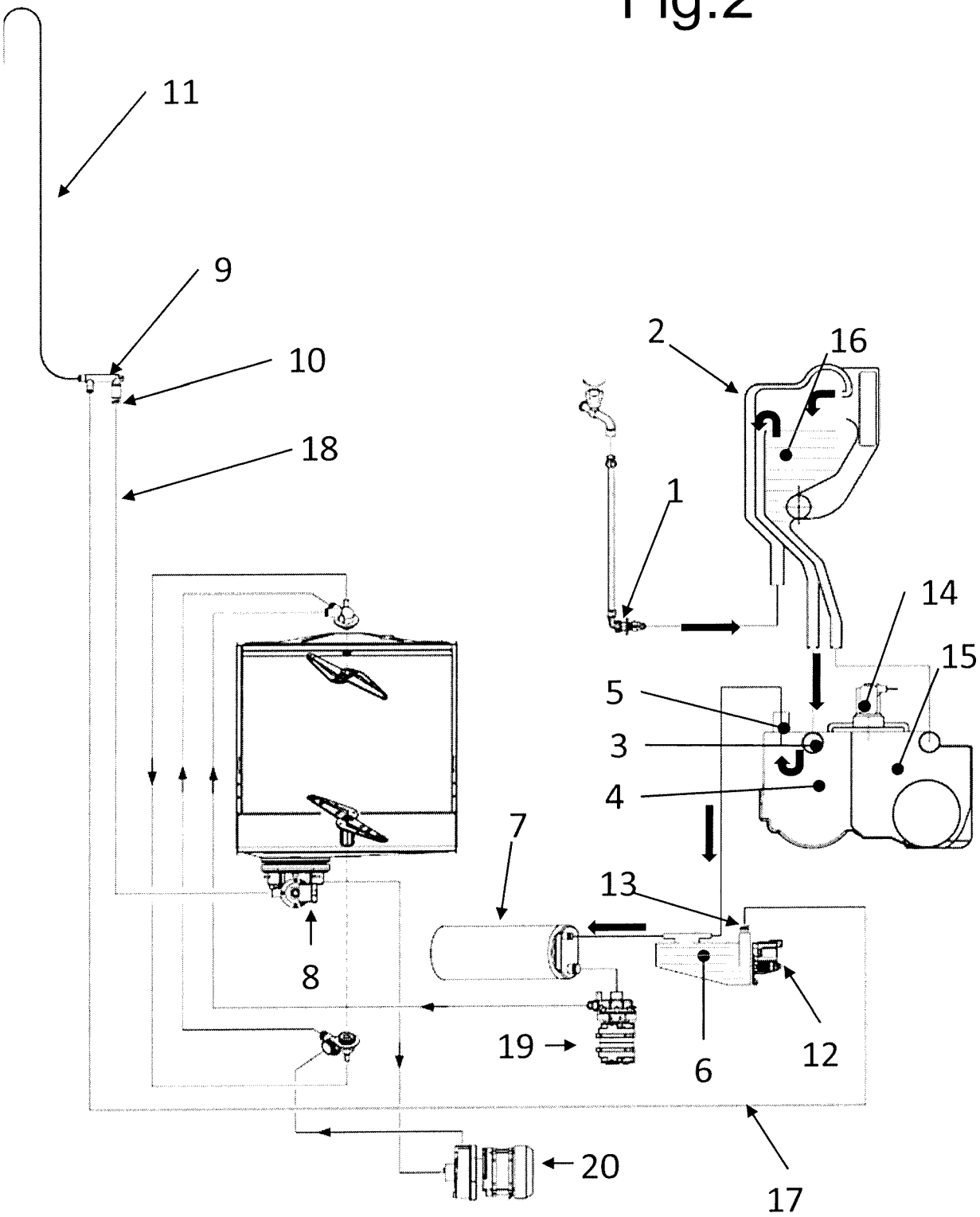


Fig.3

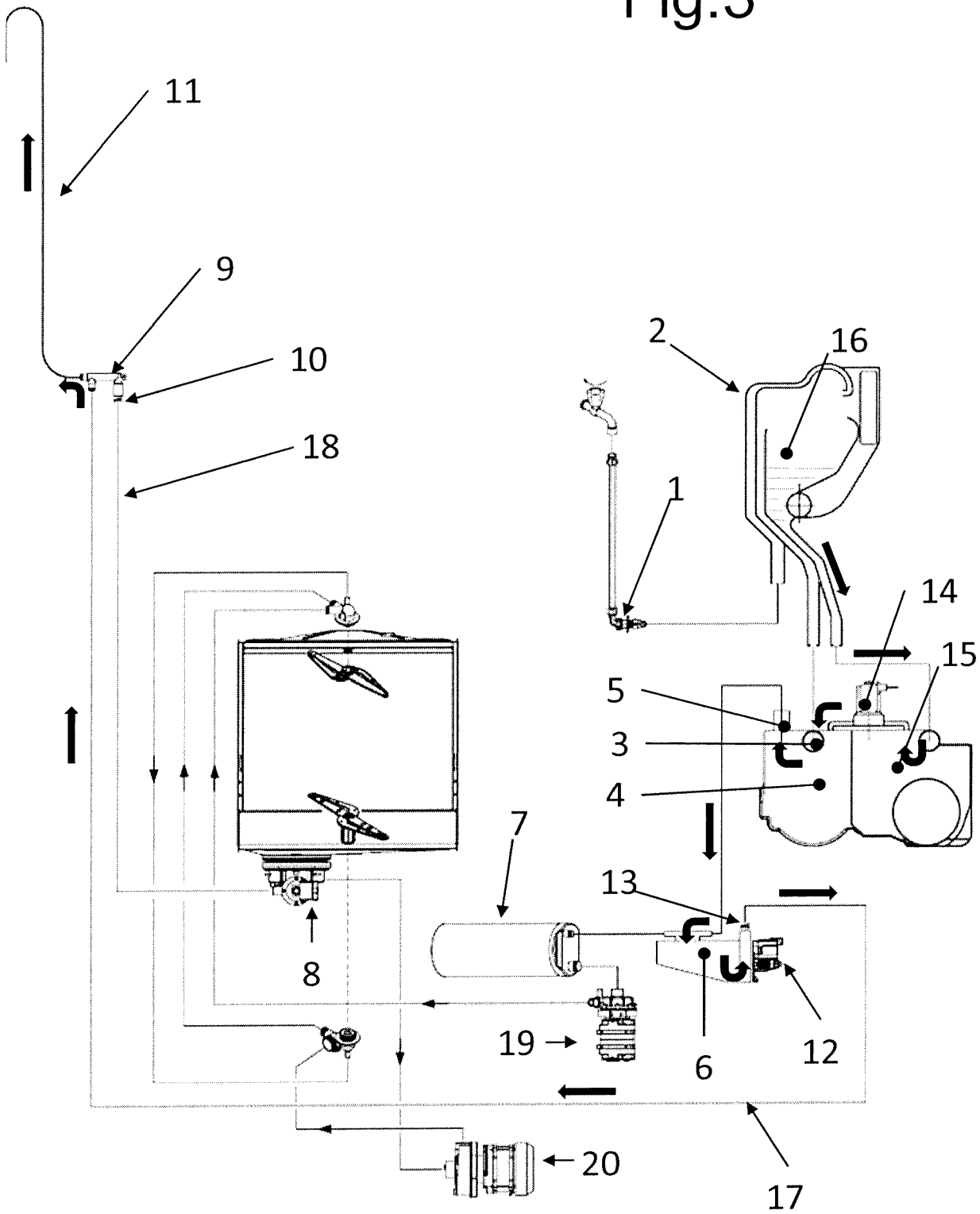
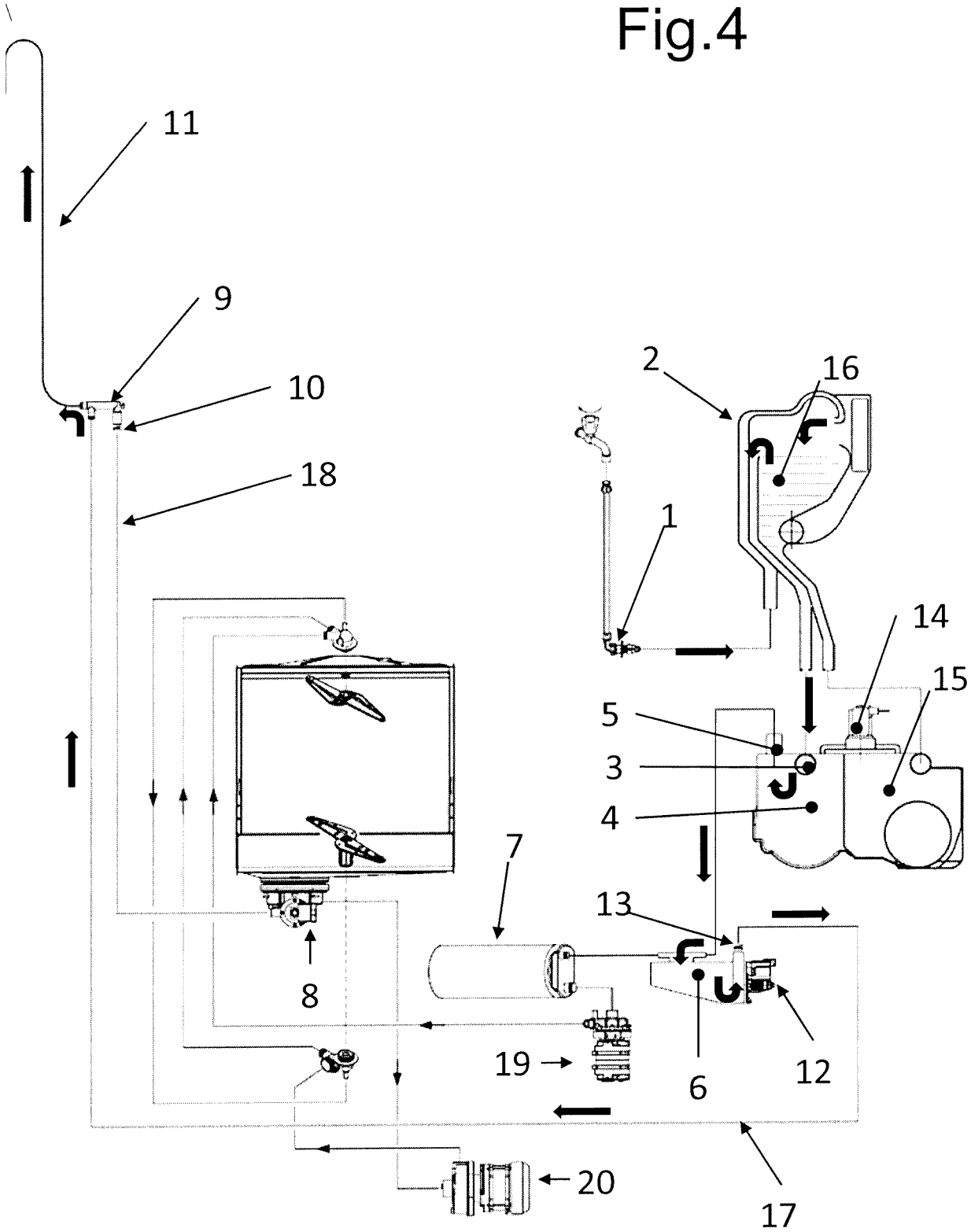


Fig.4



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EUROPEAN SEARCH REPORT

Application Number
EP 18 42 5098

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 623 013 A1 (BONFERRARO SPA [IT]) 7 August 2013 (2013-08-07) * the whole document *	1-9	INV. A47L15/42
A	EP 1 905 339 A1 (BONFERRARO SPA [IT]) 2 April 2008 (2008-04-02) * paragraph [0014] - paragraph [0030] *	1-9	
A	WO 2005/046420 A1 (MEIKO MASCHINENBAU GMBH & CO [DE]; STREB MICHAEL [DE] ET AL.) 26 May 2005 (2005-05-26) * page 6, line 30 - page 9, line 25 *	1-9	

TECHNICAL FIELDS SEARCHED (IPC)

A47L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 April 2019	Jezierski, Krzysztof

CATEGORY OF CITED DOCUMENTS

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02-04-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2623013 A1	07-08-2013	NONE	
EP 1905339 A1	02-04-2008	AT 417540 T	15-01-2009
		EP 1905339 A1	02-04-2008
		ES 2317481 T3	16-04-2009
WO 2005046420 A1	26-05-2005	DE 10352120 A1	16-06-2005
		EP 1680006 A1	19-07-2006
		WO 2005046420 A1	26-05-2005

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