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(54) **Ice maker integrated with drink dispenser**

(57) Ice maker comprising a freezing bin, an evaporator accommodated inside said freezing bin, a reservoir for storing the water to be introduced in said freezing bin, means for adjusting the flow of water being introduced in said freezing bin, a first conduit connecting the interior of said reservoir with the internal volume of said freezing bin, a first water supply pump included in said first conduit; there are provided means adapted to enable at least part of the water contained in said freezing bin to flow back again into said storage reservoir, and said water flow-back means comprise a second conduit.

In said first or in said second conduit there are provided de-ionizing filters adapted to at least partially intercept the salts dissolved in the water flowing therethrough.

Said ice maker is provided with appropriate, selectively operable pumps included in said conduits, so that the whole amount of water that is not frozen to ice is caused to flow back again into said storage reservoir. In addition, said storage reservoir is arranged to also supply a drink dispenser.

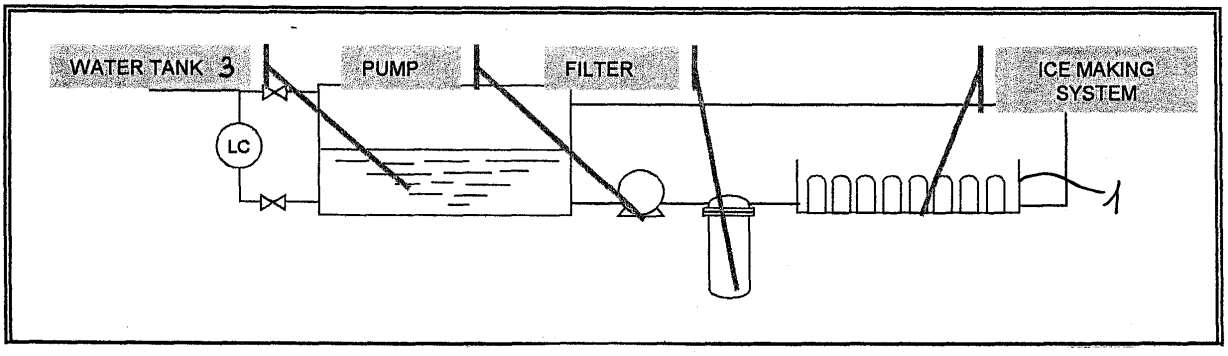

FIG. 1

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Description

[0001] The present invention refers to an improved kind of ice maker provided with means and operating peculiarities adapted to produce clear ice cubes, while at the same time doing away with the need for water parts that are not converted into ice cubes to be periodically let out into the outside ambient.

[0002] Although reference will be made to an ice maker of the type intended for use in households throughout the following description, it is understood that the related explanations and illustrations similarly and equally apply also to any other kind of ice-making apparatus for professional and industrial applications.

[0003] Ice-making apparatuses are known in the art, which are designed and made to operate in view of being able to periodically produce a certain, limited amount of ice cubes for various uses.

[0004] In these appliances, ice is made by submerging a properly shaped cooling evaporator in a tank or pan filled with water to be converted into ice cubes; known in the art there are in this connection also operating solutions based on spraying - from the bottom - a controlled amount of water against a vertical evaporator, so as to accelerate the ice-making process to a certain extent.

[0005] A well-known phenomenon tends to occur during production of ice cubes, in that it is quite frequently observed that the ice forming the cubes does not look clear, but rather opaque and veined with a number of streaks extending therethrough.

[0006] It is a phenomenon that is mainly due to the fact that the water being used in such appliances is usually taken in from the water supply mains and, therefore, regularly contains a certain, normal percentage of salts - and respective ions - dissolved therein.

[0007] The presence of such elements cannot be eliminated from the ice being formed, so that it appears there in the form of a readily and distinctly perceived opacity. Anyway, this phenomenon is largely known in the art, so that no need arises here for it to be dealt with any further.

[0008] Such presence of salts and related ions in the ice cubes is usually considered as being generally acceptable and, in fact, gives no rise to practical problems or drawbacks to any serious extent. However, in particular applications and fields of use, as mainly this is known to occur in public houses and catering operations such as inns, restaurants and similar places of refreshment, but quite frequently also in private households, drinks and beverages are most desirably served with ice cubes that even visually confer a sensation or impression of superior quality. In this connection, it can therefore be readily appreciated that, if the ice cubes turn out as being opaque or streaked, as this generally is found to occur when prior-art ice-making equipment and processes are used, such requisite falls short of being complied with to any satisfactory extent.

[0009] In view of doing away with this drawback, a known remedy lies in bringing about - in the container where the ice cubes are being produced - a continuous agitation of the water around the evaporator, such agitation being in fact effective in facilitating a migration of the dissolved salts from the water being frozen into ice towards and into the water portions that remain in the liquid state, i.e. fail to be converted into ice, in which the concentration of salts tends therefore to gradually increase, thereby decreasing the concentration of salts in the ice accordingly.

[0010] Unfortunately, this generally beneficial effect does not always prove sufficient and adequate in view of reaching the desired result, owing mainly to the fact that - after a first group of ice cube has been removed for use - the water that must be converted into new ice cubes tends obviously to have a concentration of salts that is certainly greater than the one in the previously used water, and this unavoidably leads to a poorer quality of the ice forming the new cubes.

[0011] It can be readily appreciated that such effect tends to become worse and worse as new ice cubes are from time to time produced, while the quality of the ice of the new cubes suffers an increasing deterioration as far as the visual impression thereof is concerned.

[0012] Figure 9 shows a graph - as determined experimentally on a lab test bench - of the progressively increasing value of water conductivity versus ice production in a prior-art ice-making apparatus.

[0013] In view of totally doing away with this problem, known in the art is the solution based on providing devices or arrangements that are adapted to periodically let off excess water remaining in the ice-cube production container and not used for producing such ice cubes.

[0014] Such excess water being let off, which most obviously has a high concentration of salts, is replaced with fresh water taken in from the water supply mains, i.e. tap water, whose concentration of therein dissolved salts is a normal one, i.e. far lower than the salt concentration in the formerly removed water. And the ice-cube making process can then be repeated cyclically.

[0015] However, this operating mode, although quite effective as far as the ice-cube production is concerned, fails to be equally effective from a general point of view, since it makes it necessary for special devices and operating modes to be provided and devised for the water being in this way removed to be let off outside the ice-making apparatus itself, where it further needs to be properly disposed of. This quite clearly adds complications - and costs - in the overall construction, along with additional complications and costs in the installation of these ice makers.

[0016] It would therefore be desirable, and it is a main object of the present invention, to provide an ice maker that does completely and radically away with all of the afore-mentioned drawbacks and problems, is able to produce perfectly clear ice cubes of excellent quality, and does not require any water to be let off outside.

[0017] According to the present invention, these aims, along with further ones that will become apparent from

the following disclosure, are reached in an ice maker, and a drink dispenser associated thereto, incorporating the features as defined and recited in the appended claims.

[0018] Features and advantages of the present invention will anyway be more readily understood from the description that is given below way of nonlimiting example with reference to the accompanying drawings, in which:

- Figures 1 to 3 are respective views of different embodiments of the water circuit in an ice maker according to the present invention;
- Figures 4 and 5 are respective views of further embodiments of the water circuit in an ice maker according to the present invention, to which there is associated a drink dispenser of a kind known as such in the art;
- Figure 6 is a symbolical view of a cyclograph concerning an operating mode of an ice maker as shown in Figure 3;
- Figures 7A through to 7E are schematical views illustrating respective operating states relating to the ice maker in the embodiment shown in Figure 3;
- Figure 8A is a block-diagram view of a schematic sequence of actions and operating states of the ice maker shown in Figure 3, including the devices of an ice maker according to the prior art that have not been illustrated in Figures 7A and 7B;
- Figure 8B is a schematic view of the sequence of some operating states of the ice maker shown in Figure 3, which are not fully represented in Figure 8A;
- Figure 9 is a graphical view of the conductivity trend of the water in an ice-making apparatus according to the prior art as a function of the quantity of ice being produced;
- Figure 10 is a graphical view of the conductivity trend of the water in an experimental type of ice-making apparatus according to the present invention, again as a function of the quantity of ice produced.

[0019] With reference to Figure 1, an ice maker according to the prior art is basically made by the association of a freezing bin 1, an evaporator 2 accommodated within said freezing bin, a reservoir 3 for storing the water to be introduced in said bin, adjusting means for controlling the inflow of water into said bin, a first conduit 4 connecting the interior of said reservoir with the internal volume of said bin 1, a first water supply pump 5 arranged in said first conduit 4.

[0020] According to the present invention, an ice maker of the above-cited kind is improved on the basis of following considerations: since one of the problems that have desirably to be solved derives from the need for excess water still existing in its liquid state in the freezing bin to be from time to time discharged outside the ice maker, while preventing the salt contents of said water from increasing gradually, the proposed solution consists in:

- having the water still contained in its liquid state in said freezing bin conveyed again into said reservoir, and
- causing the water existing in the same storage reservoir 3 to be filtered with the help of suitable filtering means in some appropriate mode and manner, as this shall be described in greater detail further on.

[0021] The above-described ice maker is therefore provided with a second conduit 6 that is adapted to convey the water from said bin again into said reservoir 3.

[0022] Five possible, different embodiments of the present invention shall now be described to illustrative purposes, along with the respective operating modes.

First embodiment

[0023] With reference to Figure 1, there is shown said second conduit 6 connecting said freezing bin directly with said storage reservoir 3; according to the invention, a de-ionizing filter of a kind generally known as such in the art, for instance the model SENIOR 3P-AFO SXAS provided by the Company NORDACQUE (Registered Trademark) established in Schio (VI), Italy, is located in the first conduit 4 in a position situated between said water supply pump 5 and said freezing bin.

[0024] When the pump is operating, it delivers a defined amount of water into said bin 1 via said conduit 4; in this way, the water must necessarily flow through said de-ionizing filter 7, thereby being purified from excess salts; in fact, the same pump, by filling said bin 4, indirectly forces the water contained therein, and which is not frozen into ice, to flow back again into the reservoir 3 via said second conduit 6 in a spontaneous manner, e.g. by overflowing and falling by gravity thereinto.

[0025] Although generally effective, such solution has however proven as being scarcely viable from a practical point of view for the simple reason that, since the de-ionizing filter 5 is located in the first conduit 4 and, therefore, arranged in series with the direction of flow of all water being delivered into the freezing bin 1, it unavoidably becomes saturated after just a rather limited number of cycles, so that it practically requires constant maintenance and rather frequent replacement.

[0026] In view of doing away with such limitation, following second embodiment is therefore proposed.

Second embodiment

[0027] With reference to Figure 2, a three-way valve 10 is provided at an branch-out point 11 of said first conduit situated between the pump 5 and the bin 1; one of the three ways of said valve is connected to a third conduit 8, the opposite end of which is connected to debouch into said storage reservoir 3, whereas the other two ways of the valve obviously correspond to the two respective branches of said first conduit.

[0028] In such configuration, said de-ionizing filter 7 is arranged to intercept the water flowing through said third conduit 8.

[0029] This embodiment of the ice maker according to the present invention allows for following mode of operation: periodically, i.e. not continuously, said three-way valve 10 is operated so as to shut the passage towards the bin 1, while clearing it towards said third conduit 8.

[0030] Practically, a by-pass flowpath extending parallel to the main flowpath through said first and second conduits 4 and 6 is established, in which the water is solely pumped for determined periods of time; therefore, by appropriately setting and selecting both the starting moments and the duration of said flow of water through said third conduit 8, and hence through said filter 7, the water filled in the reservoir 3 can be submitted to a filtering action that is certainly a partial one, but may nevertheless prove adequate in view of lowering the level of salt ions in the water to such a point as to effectively prevent the ice that said water has to produce from becoming opaque; as this has on the other hand been found and fully demonstrated in the course of a number of exhaustive experimental tests, in exchange for such compromise a valuable advantage is obtained in that the utilization of the filter 7 is considerably reduced, although the actual extent of which would of course much depend on the duty cycle thereof, which - as already noted hereinbefore - is in fact controllable in a selective manner.

[0031] Anyway, such considerable reduction in the operating time, i.e. working load of the filter leads to a comparably sensible rarefaction of maintenance actions to be scheduled for the same filter and, in particular, a marked prolongation of the time elapsing between successive replacements of the filter 7.

[0032] However, this particular embodiment, although quite effective, may still give rise to some out-of-balance condition in the general operation of the apparatus, owing mainly to the fact that, when the third conduit 8 is opened to cause the water to flow through the filter and, as a result, to be de-ionized, the three-way valve 10 shuts off the first conduit 4 leading to the freezing bin, thereby preventing fresh water from reaching said bin and, ultimately, making it practically impossible for new ice to be produced.

[0033] In this case, a new water circuit may be provided as an alternative solution to the above-described one, as illustrated below.

Third embodiment

[0034] With reference to Figure 3, there is provided a fourth conduit 12, which departs from and extends to eventually return into said storage reservoir 3, wherein said fourth conduit is provided with both a second pump 13 and said de-ionizing filter 7.

[0035] Said second pump 13 can then be activated in a manner that is fully independent on the first pump 5 and, as a result, the filtering function can be performed concurrently with and independently on the water-supply function delivering fresh water into the freezing bin, thereby overcoming the above-cited drawback.

[0036] It can be readily appreciated that, for such effect to be reached, said two pumps need of course to be selectively controllable, but this can be most easily done with the help of appropriate control means that are largely known as such in the art and fully within the abilities of those skilled in the art. Anyway, these means shall be preliminarily provided with all necessary operational and timing data so as to enable them to deliver the proper signals to said pumps and said valve, as applicable.

[0037] The operation of an ice maker according to this third embodiment of the present invention is symbolically represented in the Figures 7A through to 7E. These Figures in fact illustrate in a symbolical manner the characteristics of the water circuit of the ice maker - as well as of other devices and parts entering the construction thereof, which, owing to them being plainly evident by themselves and adequately described in the Figures, shall however not be explained here any further - in some basic operating states thereof.

[0038] Not explained in these Figures are the most specific functionalities of the cooling and defrost circuits, which are on the contrary indicated in the schematics appearing in Figure 8A, which is a block diagram of the logic and timing sequence in the operation of the basic devices and the related functions in an ice maker according to the present invention. In this Figure, the devices according to the invention (as referred to the embodiment illustrated in Figure 3) are solely indicated, whereas the functional sequence thereof is illustrated in greater detail in Figure 8B.

[0039] To merely informative purposes, Figure 6 can be noticed to illustrate a cyclograph denoting the operating and timing sequences of the functional components of the circuit shown in Figure 3 (along with some other components that are not explicitly illustrated, but belong anyway thereto), i.e. (from the top down):

- the compressor (not shown in Figure 3),
- the water inlet valve letting water from the supply mains, or tap, into the reservoir 3,
- the water supply pump 5 delivering water to the freezing bin,
- the second pump 13,
- the control and operating means, typically a valve (not shown), for defrosting the evaporator and sep-

arating the ice cubes therefrom,

- the agitation motor (not shown) provided to stir the water in the freezing bin 1,
- the drive motor for tilting the freezing bin (to dump the ice cubes), which turns in a direction to cause the ice cubes to be released and in the reverse direction to move back into the initial position.

[0040] From this cyclograph, it may be readily noticed how:

a) the first pump 5, which is provided to fill water into the freezing bin, is operated at the beginning of the cycle for just a short period of time, see "PUMP (A)",
b) also the second pump 13 (WATER FILTER PUMP "B"), which is provided to circulate the water through the fourth conduit 12, is operated for just a short period during the cycle, this most obviously occurring solely at the end of said cycle, i.e. when the ice has already been formed and the residual water in the liquid state - having a higher concentration of salts dissolved therein - is filled back into the reservoir 3.

[0041] The cyclograph appearing in Figure 6 includes two distinct graphs, i.e. the GRAPH 1 on top and the GRAPH 2 below. In this connection, it can be noticed that these two graphs are basically identical, the sole difference lying in the fact that the upper graph does not show any operating phase of the pump 13 (B), whereas the lower graph shows this pump to operate for a short initial period of time "K"; an explanation for such difference may be found in the fact that, during a certain cycle (upper graph), the salt content of the water has not yet reached up to a level causing the filtering and de-ionizing means for said water to be activated, whereas the lower graphs illustrates another cycle whatsoever, in which said triggering level of salt content in the water has however been reached at any preceding moment whatsoever, so that, at the beginning of the corresponding cycle, said pump 13 is operated through a short, predefined period of time "K".

[0042] The graph in Figure 10 shows the behaviour of the conductivity value of the water in the storage reservoir 3 after a filtering operation, as found in a test prototype of an ice maker according to this third embodiment of the present invention. Laboratory tests, as supported by numerical analysis, showed that it is possible for a daily amount of up to 3.0 kg of ice cubes to be produced by only filtering just one litre of water from the water reservoir 3. If some water is in the meantime tapped from this reservoir for drinking purposes, an effective lifetime of up to three months can be estimated with acceptable approximation for the filter, wherein the time interval between successive replacements of the filter can obviously vary to even a significant extent, depending on the actual hardness degree of the tap water being used and the amount of ice being produced.

Fourth embodiment

[0043] With reference to Figure 4, there is provided a fifth conduit 14 that branches off a three-way valve 30 provided downstream of the water inlet valve 31, and eventually debouches into said freezing bin 1. The filter 7 is arranged in the flow passage of said fifth conduit 14; since this filter 7 is therefore directly reached by the water flowing in from the water supply mains - and hence at an adequate supply pressure - no need practically arises for any pump to be specially provided to increase the water pressure upstream of the same filter 7.

[0044] The third way of said three-way valve 30 connects to a sixth conduit 32 leading into said storage reservoir 3.

[0045] In turn, the first conduit 4 and said fifth conduit 14 lead into the freezing bin 1, from which there branches off said second conduit 6 that - as in the cases considered before - conveys the residual unfrozen water back again into said storage reservoir 3.

[0046] The operation of the ice maker according to this fourth embodiment of the present invention may now be most readily understood: in fact, if the ice maker is wished to operate in a traditional manner, i.e. without de-ionizing filter 7, said valve 30 diverts the flow of tap water towards the conduit 32 leading into the reservoir 3, from which said water is caused to flow further on towards the freezing bin 1 by the action of the pump 5 in the conduit 4.

[0047] When the ice maker is on the contrary wished to operate with filtered, i.e. de-ionized water being let into the water circuit and, in particular, directly into the freezing bin 1, the electromagnetic valve 30 is switched over so as to selectively supply with tap water the fifth conduit 14, which conveys the filtered water directly into the freezing bin 1, thereby most effectively and entirely using up the water that has just been filtered.

Fifth embodiment

[0048] With reference to Figure 5, this illustrates a last example of an embodiment of the present invention, which is rather a variant of the afore-considered fourth embodiment, based substantially on following modifications:

1) the tap water inlet valve 40 is not a simple valve, but rather a three-way valve,

2) the two outlet ways of this valve 40 connect to a sixth conduit 41 and a seventh conduit 42, respectively, both such conduits leading into said reservoir 3; as a result, there is no direct supply of such water into the freezing bin 1;

3) said de-ionizing filter 7 is provided in one of said conduits, as represented by the sixth conduit 41 in the illustration of Figure 5.

[0049] As compared with the previously considered embodiment, this embodiment suffers actually a penalty in that the filtered water flowing in from the water supply mains through the filter 7 is eventually mixed with the water that is already present in the reservoir 3, before being in turn delivered into the freezing bin 1. However, this embodiment offers in exchange an advantage deriving from the possibility for the use of a two-way valve (the valve 31 in the afore-considered example) to be saved along with the related connections and control means.

[0050] Those skilled in the art will have by now been fully able to understand that the control means as cited hereinbefore are means that are capable of going through one or more previously set and stored "programmes", the technical nature of these means (i.e. microprocessor-based control unit, electromechanical timer or programme sequence control switch, and the like), along with the related selection, arrangement and connecting circuits, is fully within the ability of those skilled in the art, so that no need arises here for them to be dealt with any further, owing to also them not being included within the scope of the present invention, actually.

[0051] The configurations that have just been illustrated of an ice maker according to the present invention anyway allow for a further advantageous and practical improvement, along with an accompanying valuable extension in the utilization scope. In fact, it is a rather common practice to have ice makers - as used in particular in household-type refrigerators - suitably associated with a drink dispenser, i.e. an apparatus that is adapted to dispense metered amounts of refrigerated beverages.

[0052] With reference to Figures 4 and 5, such drink dispenser may be integrated with the inventive ice maker by providing a fifth conduit 20 between said storage reservoir 3 and the drink dispenser 21.

[0053] Generally, this conduit 20 is not associated to any specially dedicated pump, and the water simply flows from the reservoir 3 to reach, i.e. fall into the drink dispenser by gravity, although it can be readily appreciated that this function may of course be supported by installing a special pump (not shown) to such purpose. Anyway, said reservoir 3 is fitted so as to also act as a supply reservoir for the drink dispenser.

[0054] The advantage of such improvement lies in the fact that, further to eliminate the use and the costs of a special reservoir - along with the related valves and fittings - for the drink dispenser, no need at all arises for a special beverage cooling system to be installed for the same drink dispenser, since the water flowing back into the storage reservoir 3 from the freezing bin 1 is anyway at a temperature close to 0°C so that, by mixing with the inflowing tap water in said reservoir 3, it forms a water mixture at an optimum temperature for dispensing and drinking.

[0055] The ice maker itself can operate to perform its own function in a substantially conventional manner. In particular, said freezing bin 1 undergoes agitation throughout the freezing process, as this is shown in the cyclograph appearing in Figure 6, in view of improving migration of salt ions, as this has already been explained hereinbefore.

[0056] Finally, and with reference again to Figures 2 and 3, there is advantageously provided a conductivity sensor 24, which is adapted to measure the conductivity of either the water contained in the reservoir 3 or the water being recirculated to and from said reservoir 3.

[0057] This sensor 24, which may be of any kind as largely known as such in the art, is included in a proper offshoot or branch 25 downstream of the filter 7 in the circuit illustrated in Figure 2, or in a respective offshoot or branch 26 downstream of said second pump 13 in the circuit illustrated in Figure 3.

[0058] As mentioned above, the purpose of this conductivity sensor is to measure the conductivity of the water in the reservoir 3 and, as a result, to indirectly measure also the concentration of salt ions in said water, based in the close and generally known relationship existing between these two physical quantities.

[0059] The signal issuing from said conductivity sensor 24 is in turn sent to the afore-cited (but not shown in the Figures) control means. These control means shall of course be duly programmed to receive such signal and, when the latter is in excess of a pre-established threshold value, activate the water circulation phase through said filter 7 or change the parameters controlling this phase, accordingly.

[0060] Fully apparent from the above description is therefore the ability of the present invention to effectively reach the aims and advantages indicated afore. In particular, also reached is the important aim of ensuring that, by appropriately selecting and setting the operating parameters and the related cycle times, the whole amount of water that reaches into said freezing bin 1 is either converted into ice cubes or fully enabled to flow back into the reservoir 3, so that any need for residual water, or anyway water that cannot be used any longer, to be let outside is fully done away with.

[0061] The afore-described embodiments that provide for the water in the freezing bin to be agitated during the freezing process, can be further and advantageously improved if the same motor used to agitate the water in said freezing bin 1 (not shown in the Figure, since largely known as such in the art) is used to also rotatably drive the same freezing bin and tilt it so as to empty said bin of the water contained therein in a still unfrozen state and cause said water to flow back into the reservoir 3 (see Figure 7C).

[0062] For this to be implemented, all it takes is to provide motor rotation control means - generally known as such in the art and, therefore, not explained here any further - that, in the appropriate time intervals and at the appropriate instants, drive said motor so as to alternately and selectively cause the bin to either undergo a swinging motion, or to perform a single rotary movement, i.e. a single rotation, in accordance to the signals being received and from time to time processed in accordance

with the process phase being carried out within the operating cycle of the ice maker.

Claims

1. Ice maker comprising:

   - a freezing bin (1) accommodating an evaporator (2) in the interior thereof or, alternatively, a freezing bin (1) associated even at the lower or bottom portion thereof to an evaporator provided with means adapted to spray a flow of atomized water thereagainst,
   - a reservoir (3) for storing the water to be introduced in said freezing bin,
   - means for adjusting the flow of water being introduced in said freezing bin,
   - a first conduit (4) connecting the interior of said reservoir with the internal volume of said freezing bin (1),
   - a first water supply pump (5) included in said first conduit (4),

   characterized in that there are provided means adapted to enable at least part of the water contained in said freezing bin to flow back again into said storage reservoir (3), and **in that** said water flow-back means comprise a second conduit (6).

2. Ice maker according to claim 1, **characterized in that** there are provided filtering means (7) adapted to at least partially filter the water contained in said storage reservoir (3).

3. Ice maker according to claim 2, **characterized in that** said filtering means are provided in said first conduit (4).

4. Ice maker according to claim 2, **characterized in that** there is provided a third conduit (8) connecting a branch-out point (11), which is located in a position between said first pump (5) and said freezing bin (1), with said storage reservoir (3), a three-way valve (10) being provided at said branch-out point (11), and said filtering means (7) being arranged so as to filter the water flowing through said third conduit (8).

5. Ice maker according to claim 4, **characterized in that** said three-way valve (10) is operable selectively.

6. Ice maker according to claim 2, **characterized in that** there is provided a fourth conduit (12) that branches off said storage reservoir (3) to eventually debouch again into said storage reservoir (3), said filtering means (7) being provided in said fourth conduit in series with a second pump (13).

7. Ice maker according to claim 1, **characterized in that** it comprises an a three-way electromagnetic valve (30) provided in the conduit downstream of the tap water inlet valve (31), a fifth conduit (14) branching off one of the ways of said three-way valve to eventually debouch into said freezing bin (1), a filter (7) associated to said fifth conduit (14), a sixth conduit (32) branching off the remaining way of said three-way valve (30) to eventually debouch into said storage reservoir (3).

8. Ice maker according to claim 1, **characterized in that**:

   - the tap water inlet valve is a three-way valve (40),
   - the two outlet ways of said valve (40) connect to a sixth conduit (41) and a seventh conduit (42), respectively, both of which lead to said storage reservoir (3),
   - before it reaches said storage reservoir (3), said sixth conduit (41) is associated to a filter (7).

9. Ice maker according to any of the preceding claims, **characterized in that** said first pump (5) and said second pump (13) are controllable selectively.

10. Ice maker according to any of the preceding claims 1, **characterized in that** it comprises a drink dispenser (21), whose supply conduit (20) is adapted to receive water from said storage reservoir (3).

11. Ice maker according to any of the preceding claims, **characterized in that** during at least part of the freezing process taking place in said freezing bin, the latter is caused to undergo a stirring motion.

12. Ice maker according to claim 10 or 11, **characterized in that** the whole amount of water being let into said storage reservoir is delivered therefrom either into said freezing bin or to said drink dispenser.

13. Ice maker according to any of the preceding claims, **characterized in that** the water still contained in its liquid state in said freezing bin, and is not frozen into ice, is enabled to flow completely back into said storage reservoir.

14. Ice maker according to any of the preceding claims, **characterized in that** said filtering means comprise a filter adapted to reduce the concentration of ions in the liquid passing therethrough.

15. Ice maker according to any of the preceding claims, **characterized in that** it is provided with means (24) adapted to detect the value of conductivity of the water in said storage reservoir (3) and send the related information to appropriate control means,

which modify the parameters and conditions of the freezing cycle and/or water backflow cycle in accordance with the received information.

16. Ice maker according to claim 4 as combined with any of the claims 9 to 15, **characterized in that** said water conductivity detecting means (24) are provided on a respective branch (25) downstream of said filtering means (7).

17. Ice maker according to claim 6 as combined with any of the claims 9 to 15, **characterized in that** said water conductivity detecting means (24) are provided on a respective branch (26) situated downstream of said second pump (13) and debouching into said storage reservoir (3).

18. Ice maker according to any of the preceding claims, **characterized in that** it is provided with a single motor, along with means for controlling said motor, which are adapted to ensure both the stirring function of said freezing bin (1) and the turning or tilting function thereof.

Amended claims in accordance with Rule 86(2) EPC.

1. Ice maker comprising:

- a freezing bin (1) accommodating an evaporator (2) in the interior thereof or, alternatively, a freezing bin (1) associated even at the lower or bottom portion thereof to an evaporator provided with means adapted to spray a flow of atomized water thereagainst,
- a reservoir (3) for storing the water to be introduced in said freezing bin,
- means for adjusting the flow of water being introduced in said freezing bin,
- a first conduit (4) connecting the interior of said reservoir with the internal volume of said freezing bin (1),
- a first water supply pump (5) included in said first conduit (4),

characterized in that there are provided means adapted to enable at least part of the water contained in said freezing bin to flow back again into said storage reservoir (3), **in that** said water flow-back means comprise a second conduit (6), **in that** it comprises a drink dispenser (21), whose supply conduit (20) is adapted to receive water from said storage reservoir (3), **in that** there are provided filtering means (7) adapted to at least partially filter the water contained in said storage reservoir (3), and **in that** said filtering means are provided in said first conduit (4).

2. Ice maker according to claim 1, **characterized in that** there is provided a fourth conduit (12) that branches off said storage reservoir (3) to eventually debouch again into said storage reservoir (3), said filtering means (7) being provided in said fourth conduit in series with a second pump (13).

3. Ice maker according to claim 1 or 2, **characterized in that** it comprises an a three-way electromagnetic valve (30) provided in the conduit downstream of the tap water inlet valve (31), a fifth conduit (14) branching off one of the ways of said three-way valve to eventually debouch into said freezing bin (1), a Biter (7) associated to said fifth conduit (14), a sixth conduit (32) branching off the remaining way of said three-way valve (30) to eventually debouch into said storage reservoir (3).

4. Ice maker according to any of the preceding claims, **characterized in that** said first pump (5) and said second pump (13) are controllable selectively.

5. Ice maker according to any of the preceding claims, **characterized in that** during at least part of the freezing process taking place in said freezing bin, the latter is caused to undergo a stirring motion.

6. Ice maker according to any of the preceeding claims, **characterized in that** the whole amount of water being let into said storage reservoir is delivered therefrom either into said freezing bin or to said drink dispenser.

7. Ice maker according to any of the preceding claims, **characterized in that** the water still contained in its liquid state in said freezing bin, and is not frozen into ice, is enabled to flow completely back into said storage reservoir.

8. Ice maker according to any of the preceding claims, **characterized in that** said filtering means comprise a filter adapted to reduce the concentration of ions in the liquid passing therethrough.

9. Ice maker according to any of the preceding claims, **characterized in that** it is provided with means (24) adapted to detect the value of conductivity of the water in said storage reservoir (3) and send the related information to appropriate control means, which modify the parameters and conditions of the freezing cycle and/or water backflow cycle in accordance with the received information.

10. Ice maker according to any preceeding claim from claim 2 on, **characterized in that** said water conductivity detecting means (24) are provided on a respective branch (26) situated downstream of said second pump (13) and debouching into said storage reservoir (3).

11. Ice maker according to any of the preceding claims, **characterized in that** it is provided with a single motor, along with means for controlling said motor, which are adapted to ensure both the stirring function of said freezing bin (1) and the turning or tilting function thereof.

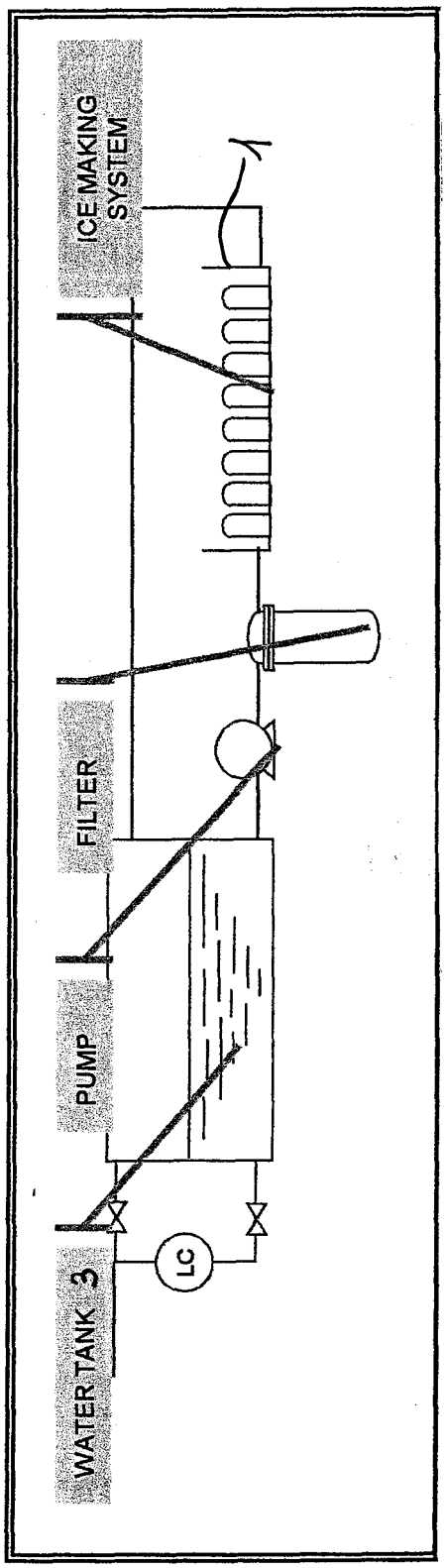


FIG. 1

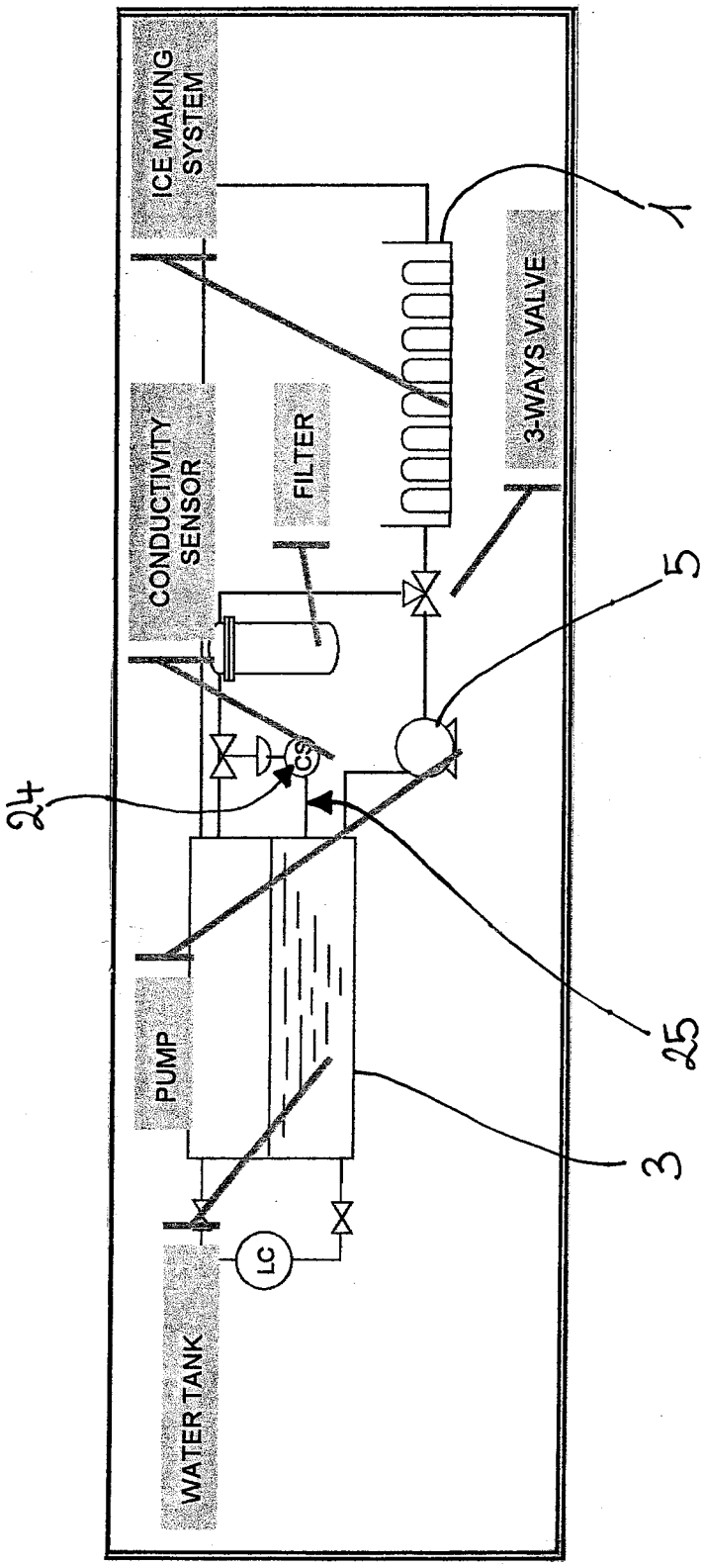

ICE MAKING SYSTEM
CONDUCTIVITY SENSOR
FILTER
3-WAYS VALVE
PUMP
WATER TANK
CS
LC
1
5
24
25
3

FIG. 2

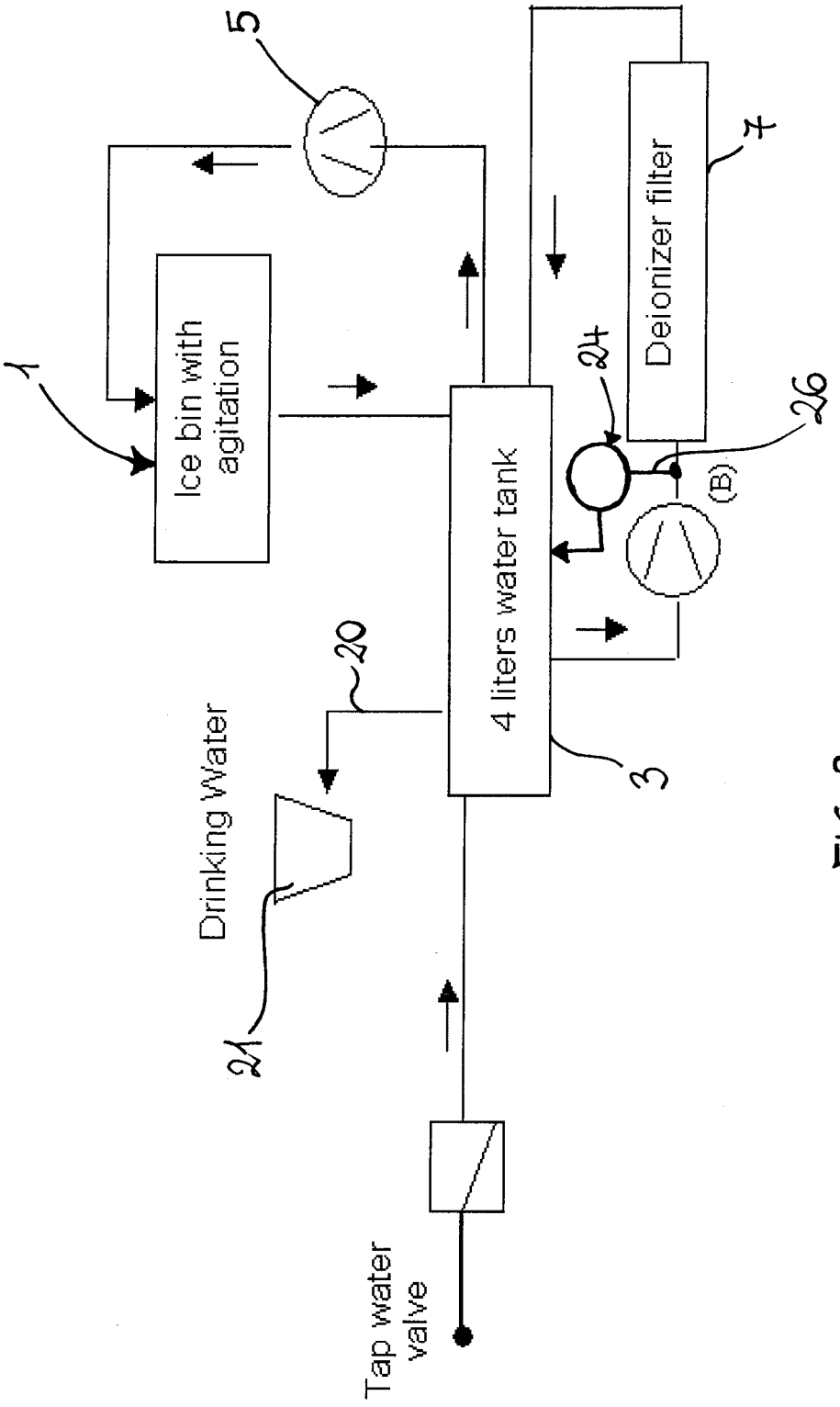

5
Deionizer filter
7
1
Ice bin with agitation
24
26
(B)
4 liters water tank
20
Drinking Water
21
3
Tap water valve

FIG. 3

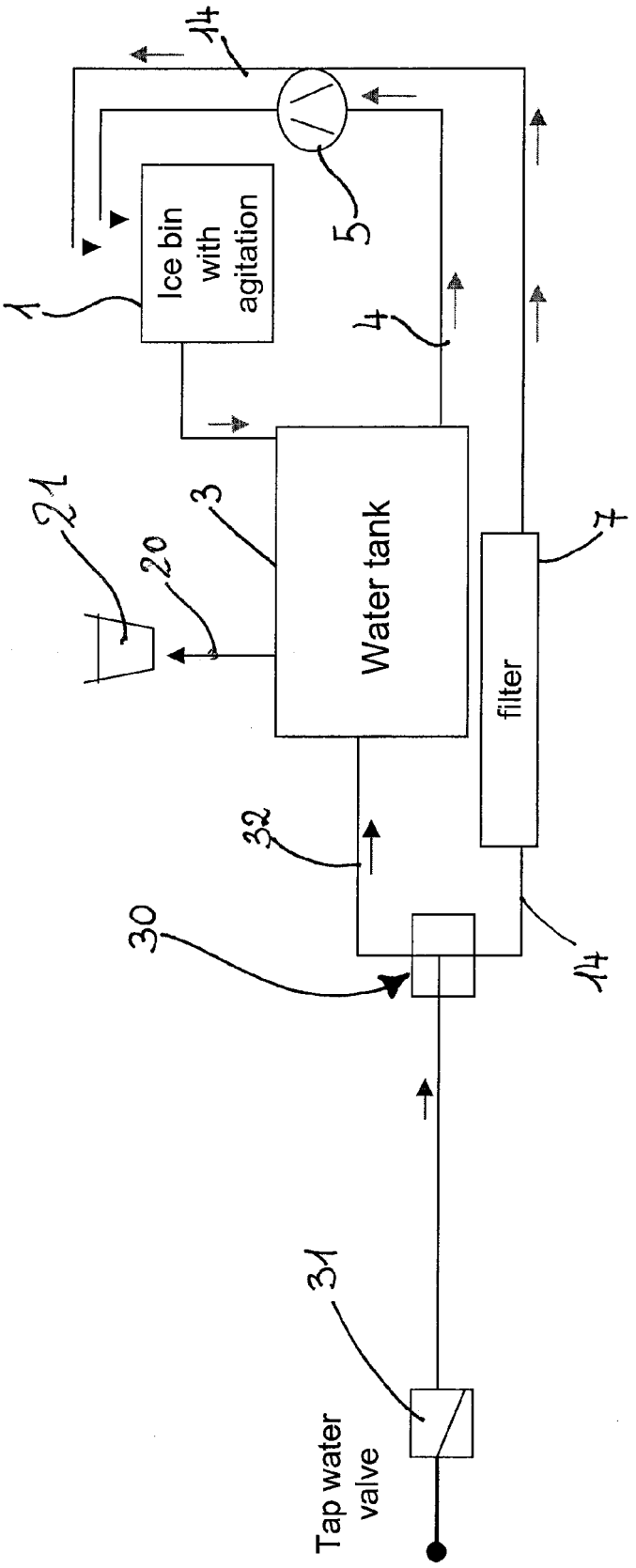

14
5
Ice bin with agitation
1
4
21
20
3
Water tank
7
filter
32
30
14
31
Tap water valve

FIG. 4

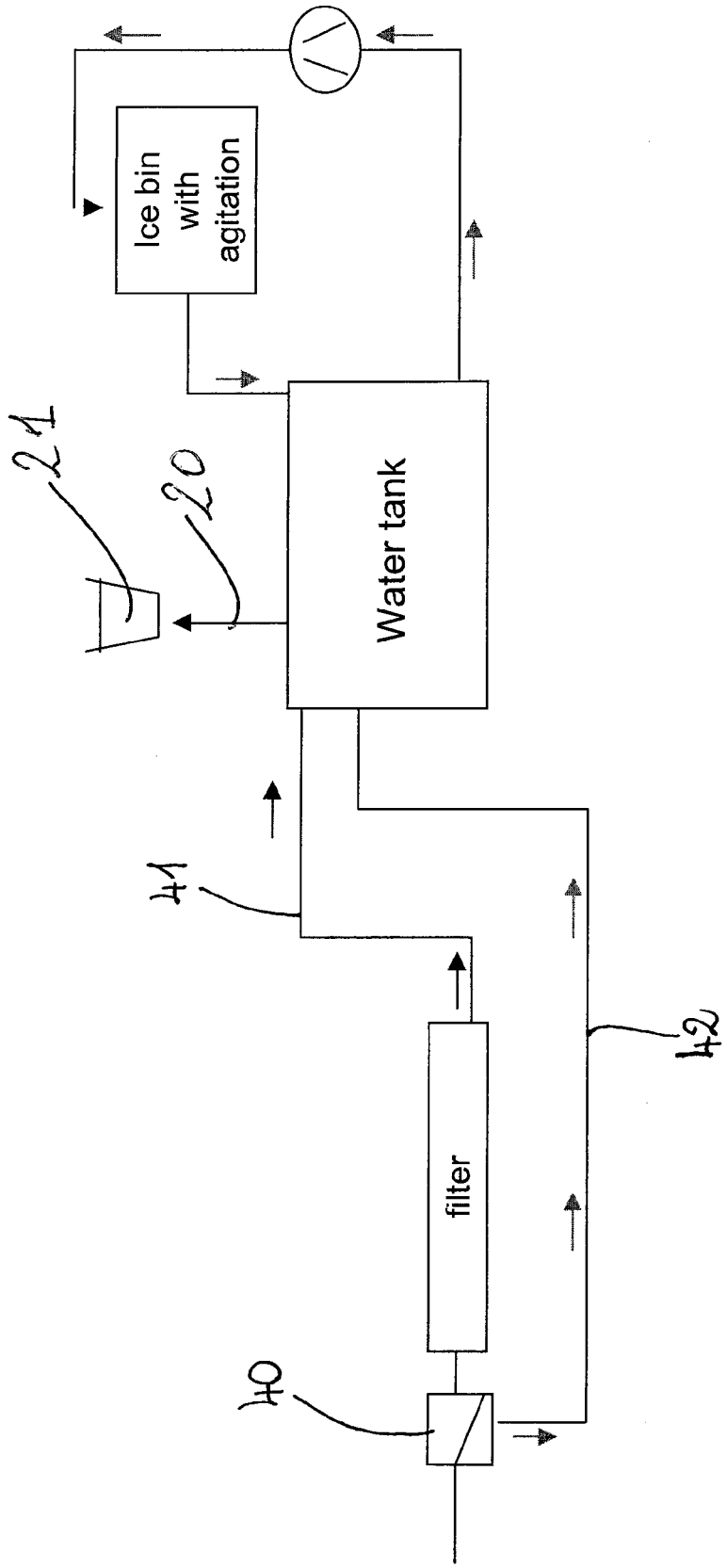


FIG. 5

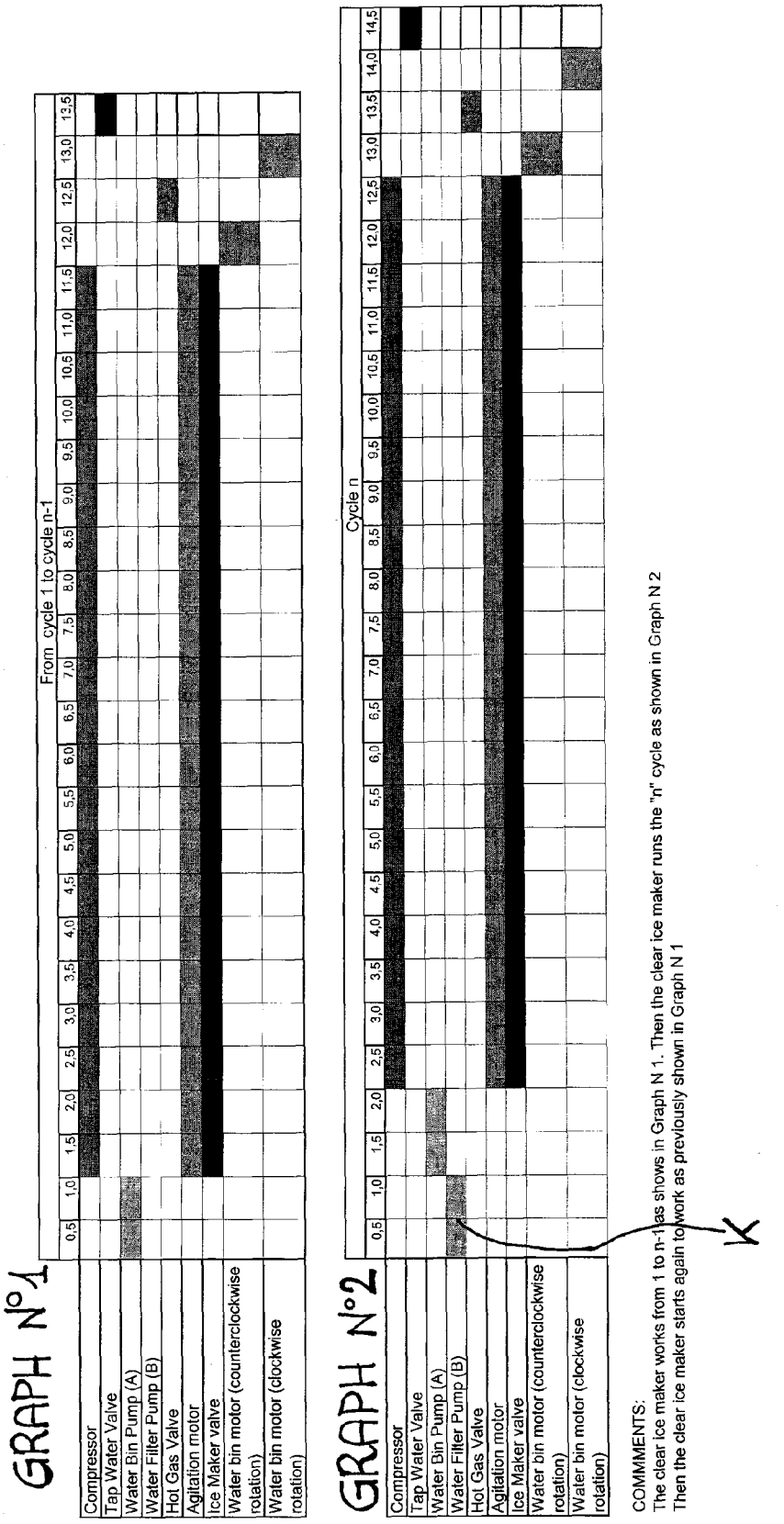

GRAPH N°1
From cycle 1 to cycle n-1
0,5 1,0 1,5 2,0 2,5 3,0 3,5 4,0 4,5 5,0 5,5 6,0 6,5 7,0 7,5 8,0 8,5 9,0 9,5 10,0 10,5 11,0 11,5 12,0 12,5 13,0 13,5
Compressor
Tap Water Valve
Water Bin Pump (A)
Water Filter Pump (B)
Hot Gas Valve
Agitation motor
Ice Maker valve
Water bin motor (counterclockwise rotation)
Water bin motor (clockwise rotation)
GRAPH N°2
Cycle n
0,5 1,0 1,5 2,0 2,5 3,0 3,5 4,0 4,5 5,0 5,5 6,0 6,5 7,0 7,5 8,0 8,5 9,0 9,5 10,0 10,5 11,0 11,5 12,0 12,5 13,0 13,5 14,0 14,5
Compressor
Tap Water Valve
Water Bin Pump (A)
Water Filter Pump (B)
Hot Gas Valve
Agitation motor
Ice Maker valve
Water bin motor (counterclockwise rotation)
Water bin motor (clockwise rotation)
K
COMMENTS:
The clear ice maker works from 1 to n-1 as shows in Graph N 1. Then the clear ice maker runs the "n" cycle as shown in Graph N 2
Then the clear ice maker starts again to work as previously shown in Graph N 1

FIG. 6

FIG. 7A

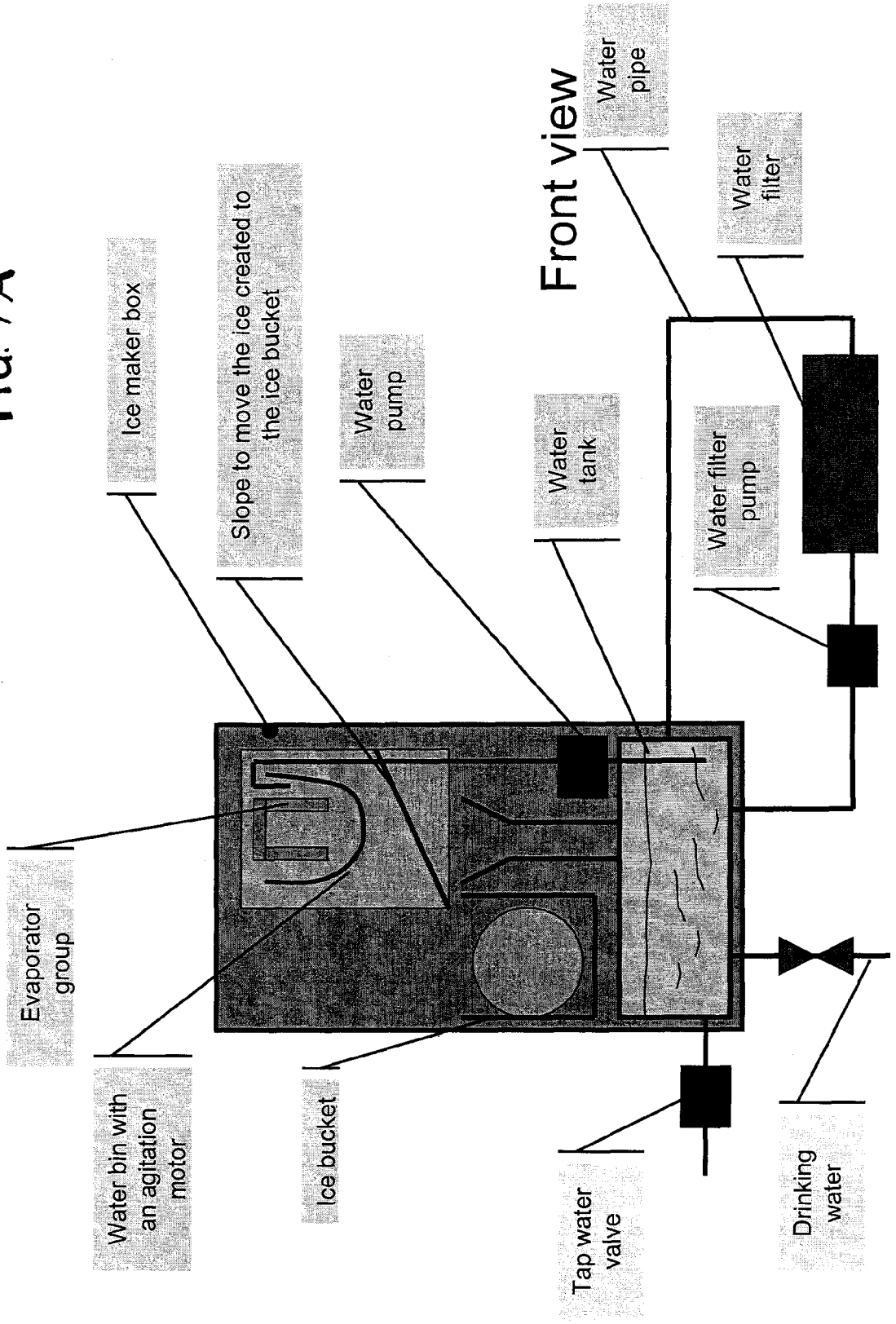

Front view
Water pipe
Water filter
Ice maker box
Slope to move the ice created to the ice bucket
Water pump
Water tank
Water filter pump
Evaporator group
Water bin with an agitation motor
Ice bucket
Tap water valve
Drinking water

FIG. 7B

During the ice creation the evaporator freezes partially the water around the fingers creating ice cubes.

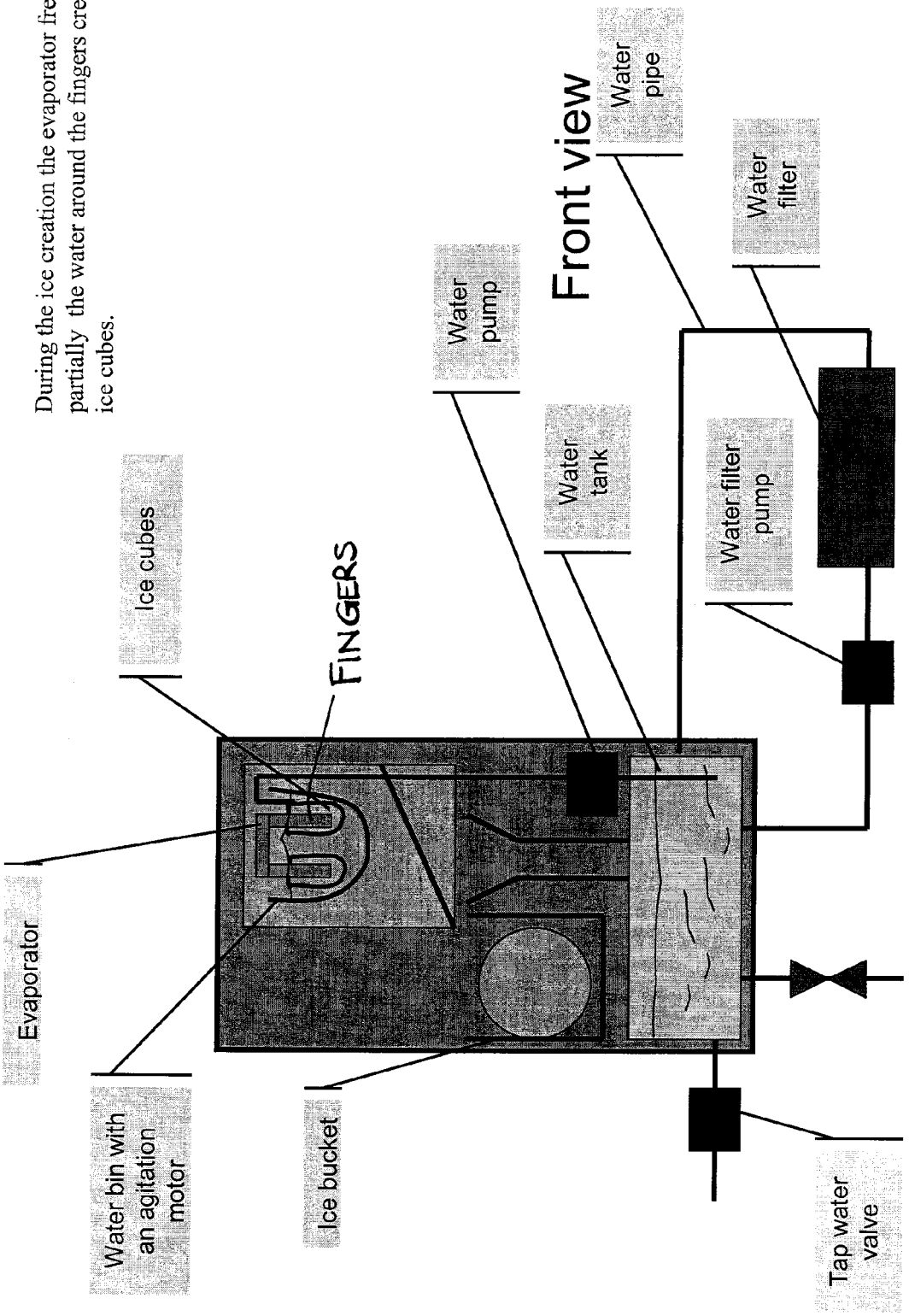


FIG. 7C

After the ice creation the water bin rotates to flush the water in the water tank.

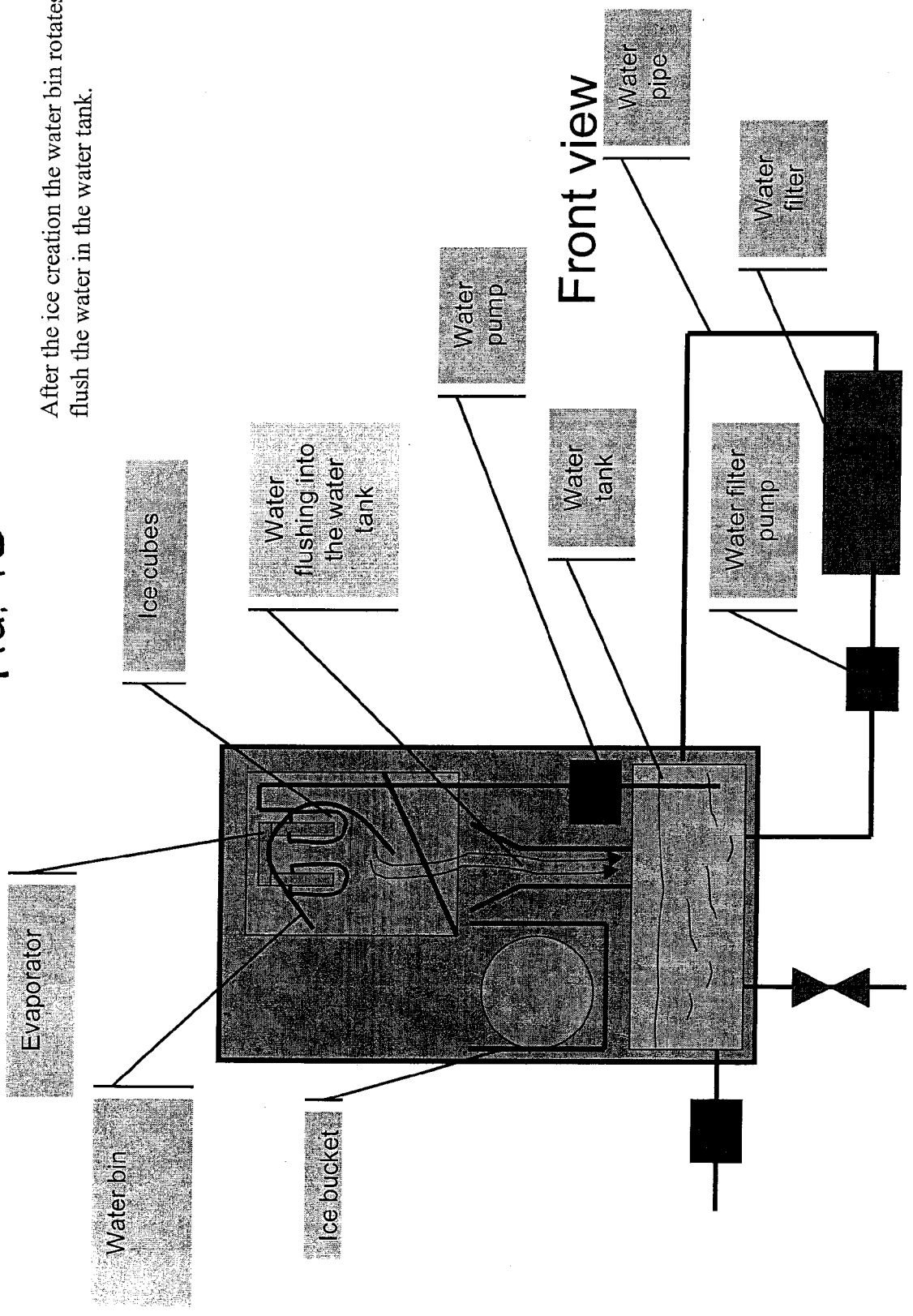


FIG. 7D

Thanks to the defrost of the evaporator the ice cubes move to the ice bucket.

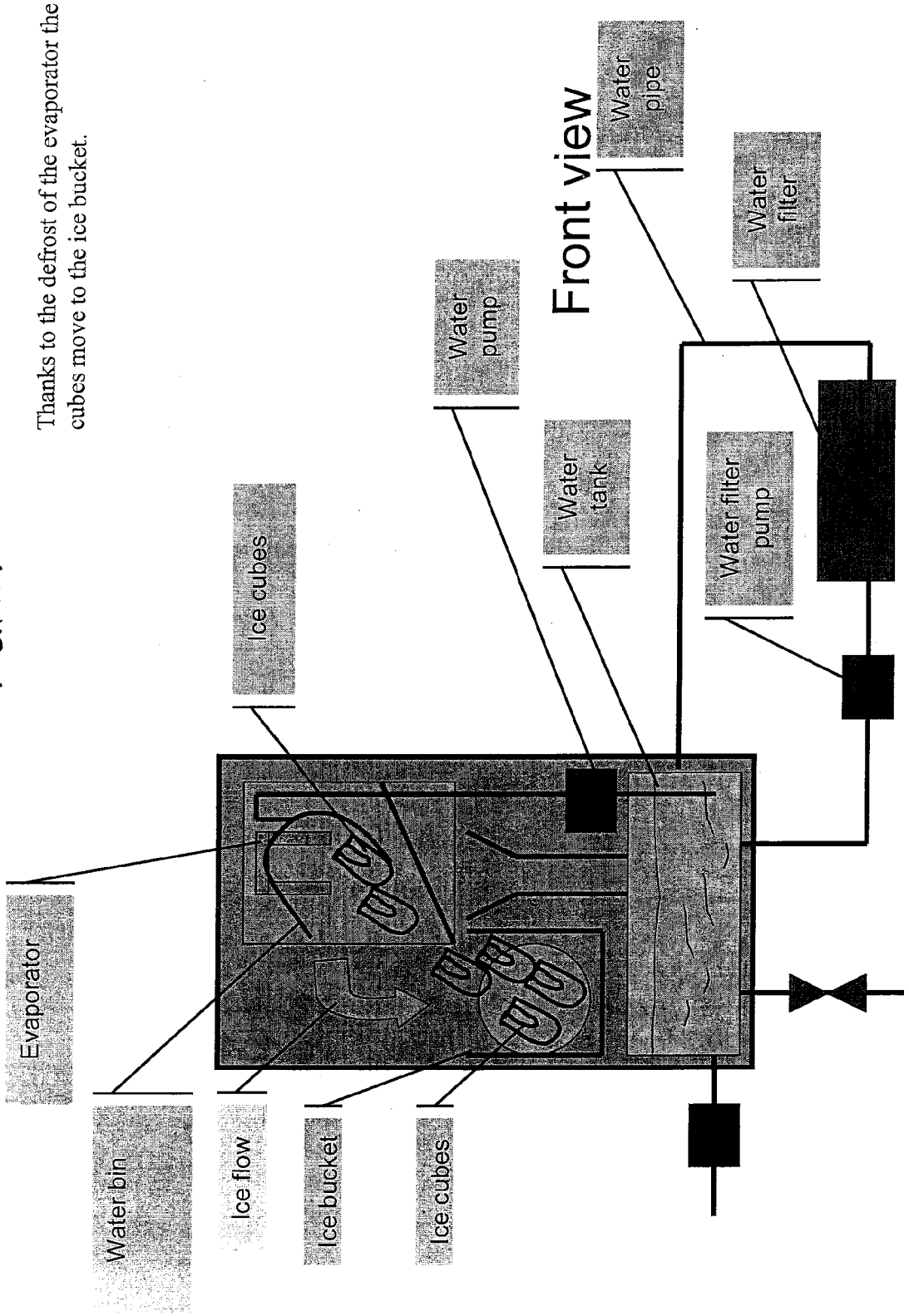


FIG. 7E

After the nth cycle the water filter pump moves the water from the water tank through the filter for a certain amount of time.

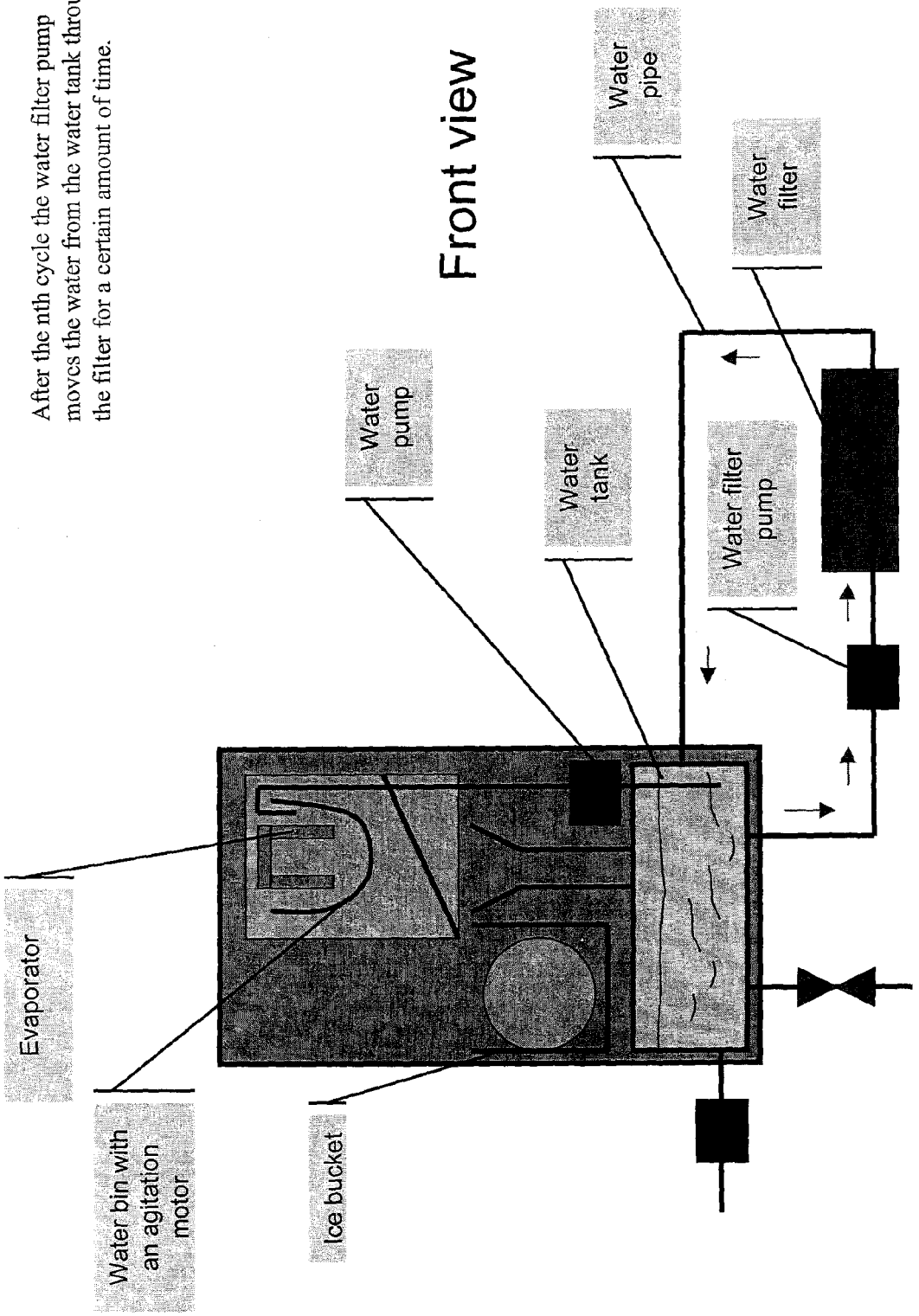
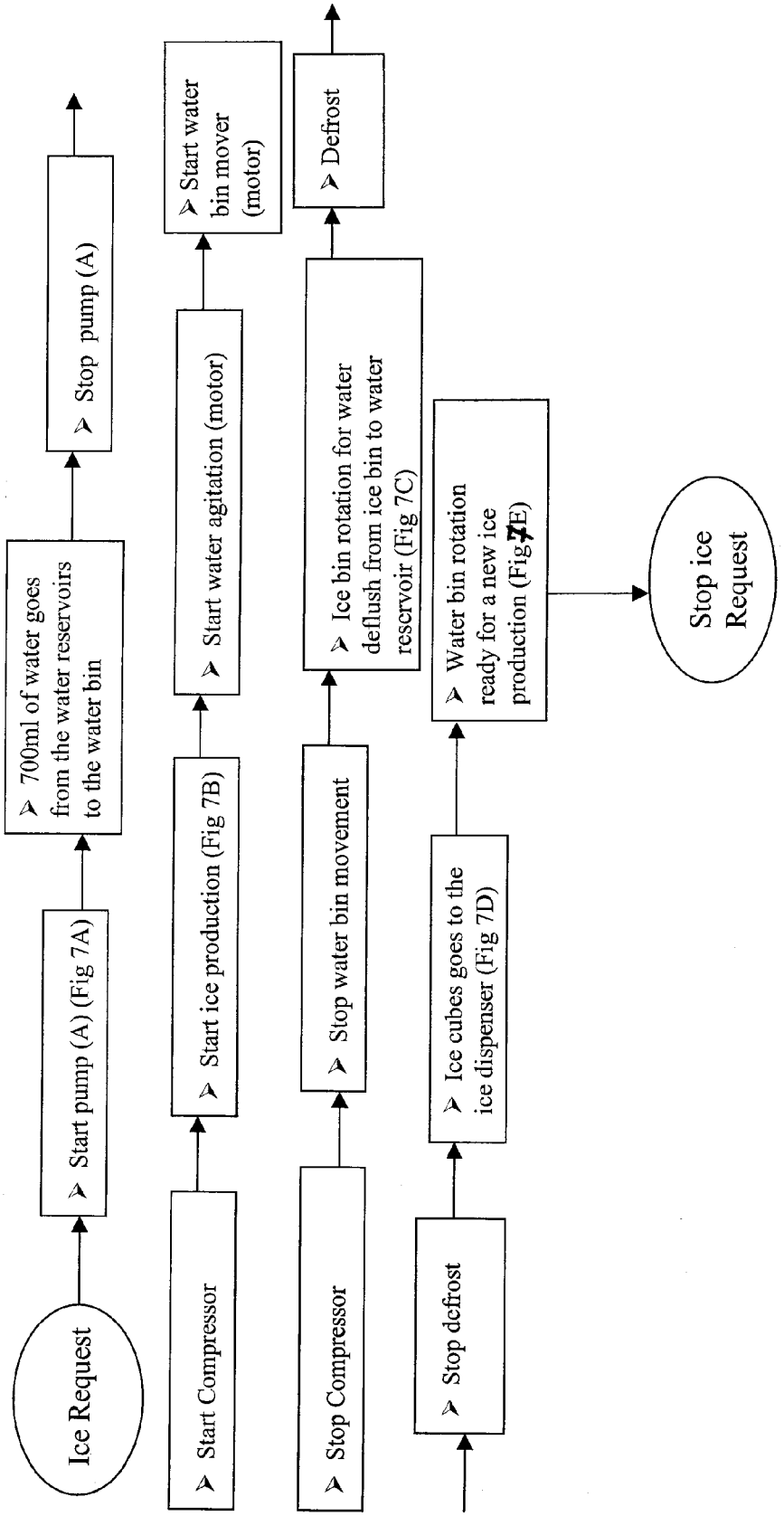


FIG. 8A


Ice Request
Start pump (A) (Fig 7A)
700ml of water goes from the water reservoirs to the water bin
Stop pump (A)
Start Compressor
Start ice production (Fig 7B)
Start water agitation (motor)
Start water bin mover (motor)
Stop Compressor
Stop water bin movement
Ice bin rotation for water deflush from ice bin to water reservoir (Fig 7C)
Defrost
Stop defrost
Ice cubes goes to the ice dispenser (Fig 7D)
Water bin rotation ready for a new ice production (Fig 7E)
Stop ice Request

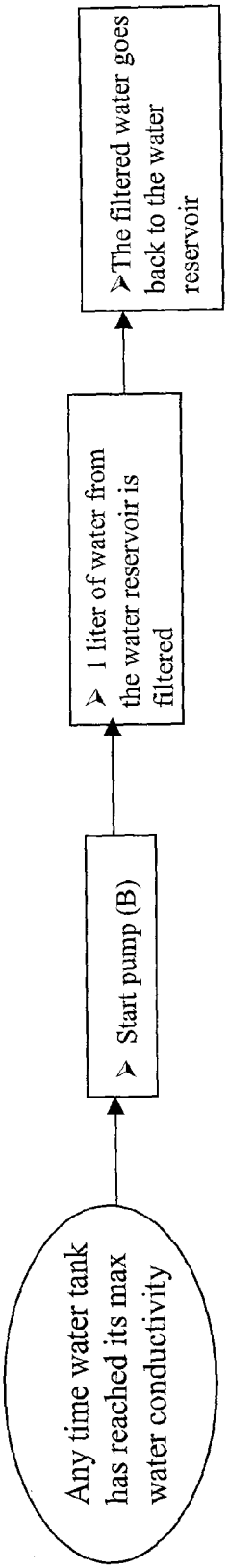

Any time water tank has reached its max water conductivity
Start pump (B)
1 liter of water from the water reservoir is filtered
The filtered water goes back to the water reservoir
Stop pump (B)

FIG. 8B

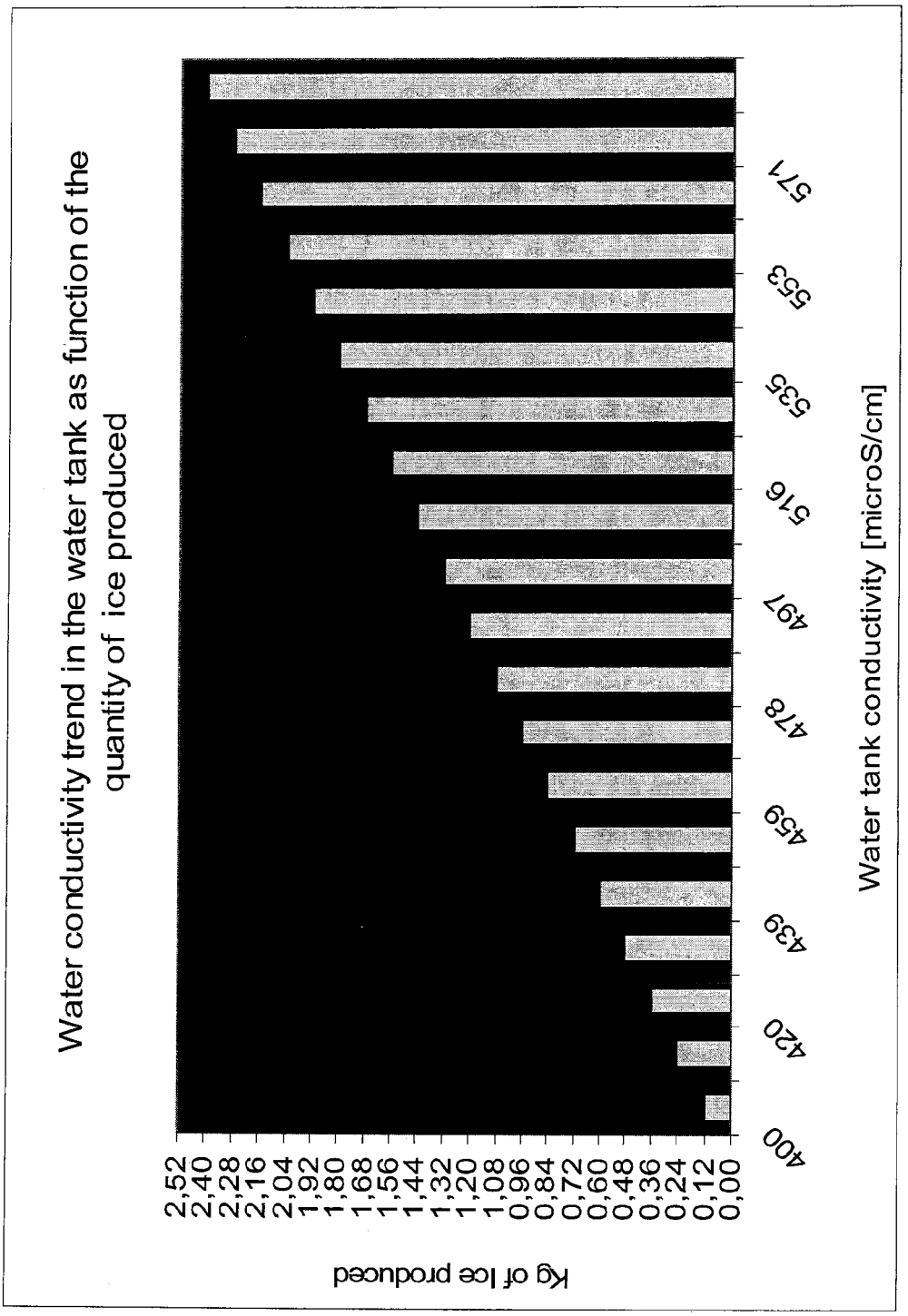

Water conductivity trend in the water tank as function of the quantity of ice produced
Kg of Ice produced
2,52
2,40
2,28
2,16
2,04
1,92
1,80
1,68
1,56
1,44
1,32
1,20
1,08
0,96
0,84
0,72
0,60
0,48
0,36
0,24
0,12
0,00
400
420
439
459
478
497
516
535
553
571
Water tank conductivity [microS/cm]

FIG. 9

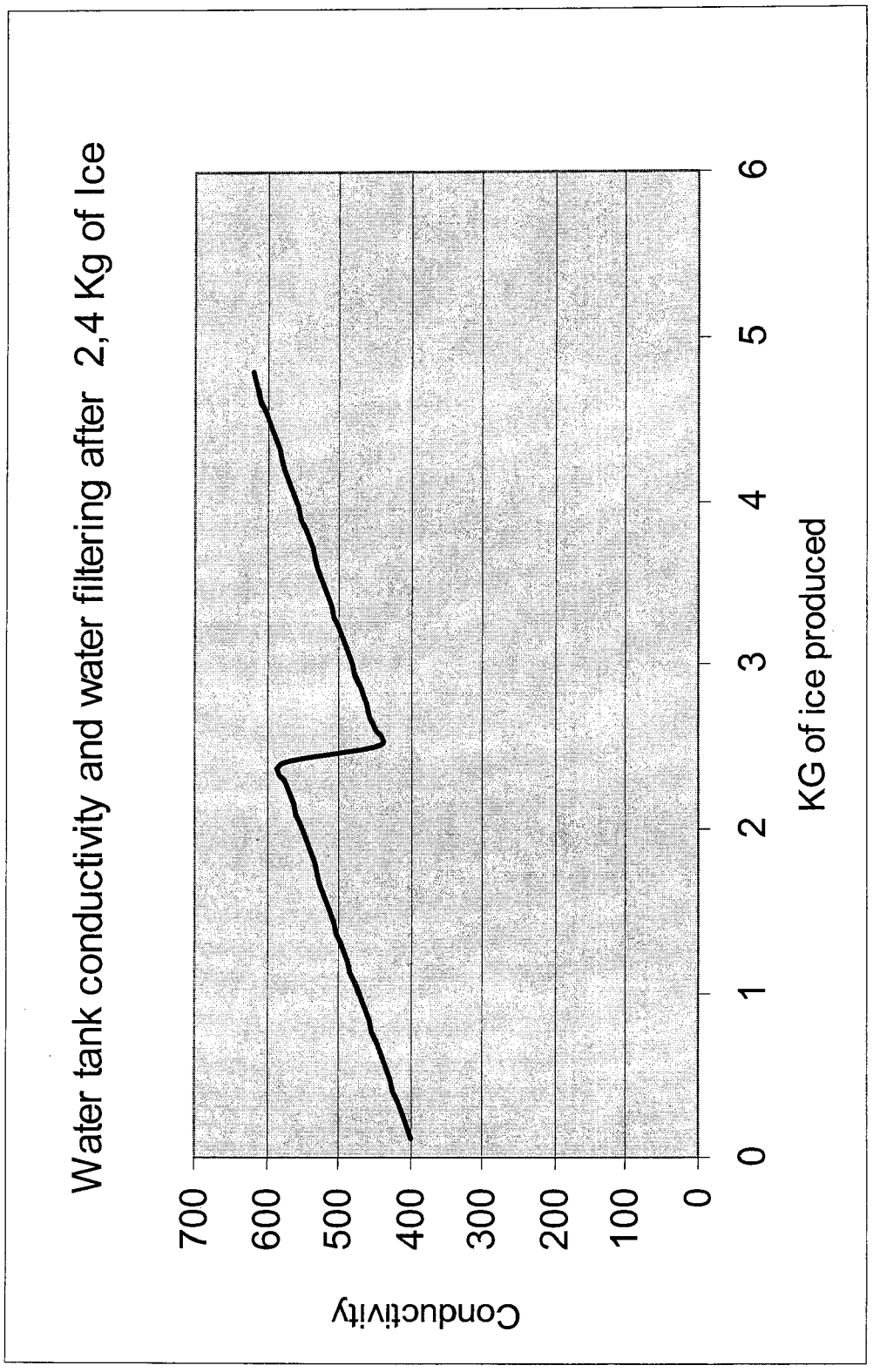

Water tank conductivity and water filtering after 2,4 Kg of Ice
Conductivity
700
600
500
400
300
200
100
0
0
1
2
3
4
5
6
KG of ice produced

FIG. 10

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 11 2247

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 848 102 A (STANFILL ET AL) 18 July 1989 (1989-07-18) * column 2, line 33 - column 3, line 66; figure 1 *	1,13	INV. F25C1/08
Y		2-6,9	
Y	EP 1 589 305 A (SAMSUNG ELECTRONICS CO., LTD) 26 October 2005 (2005-10-26) * figure 1 *	2-6,9	
X	US 5 946 924 A (KIM ET AL) 7 September 1999 (1999-09-07) * column 3, line 60 - column 4, line 58; figure 2 *	1,13	
X	EP 0 227 611 A (STAFF ICE SYSTEM S.P.A) 1 July 1987 (1987-07-01) * column 2, line 30 - column 3, line 62; figures 1,2 *	1,13	

TECHNICAL FIELDS SEARCHED (IPC)

F25C

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	28 February 2006	Salaün, E

CATEGORY OF CITED DOCUMENTS

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

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 05 11 2247

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1,2-6,9,13

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 05 11 2247

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1,2-6,9,13

   Ice maker with water filtering means
   ---

2. claims: 1,7,8

   Ice maker with tap water inlet valve
   ---

3. claims: 1,10,12

   Ice maker with drink dispenser
   ---

4. claims: 1,11,18

   Ice maker with stirring motion of the freezing bin
   ---

5. claims: 1,14

   Ice maker with filtering means adapted to reduce the concentration of ions
   ---

6. claims: 1,15,16, 17

   Ice maker with water conductivity detecting means

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 11 2247

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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28-02-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4848102 A	18-07-1989	NONE	
EP 1589305 A	26-10-2005	CN 1690631 A	02-11-2005
		US 2005235665 A1	27-10-2005
US 5946924 A	07-09-1999	CN 1204042 A	06-01-1999
		JP 11023121 A	26-01-1999
EP 0227611 A	01-07-1987	DE 3676062 D1	17-01-1991
		IT 1186470 B	26-11-1987

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82