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(54) **ICE PRODUCING DEVICE AND ICE PRODUCTION METHOD THEREOF**

(57) Described is a device and process for controlling ice production, which can be applied to any ice-making appliance, designed for producing a defined amount of ice and/or producing a defined amount of ice by a certain date and time.

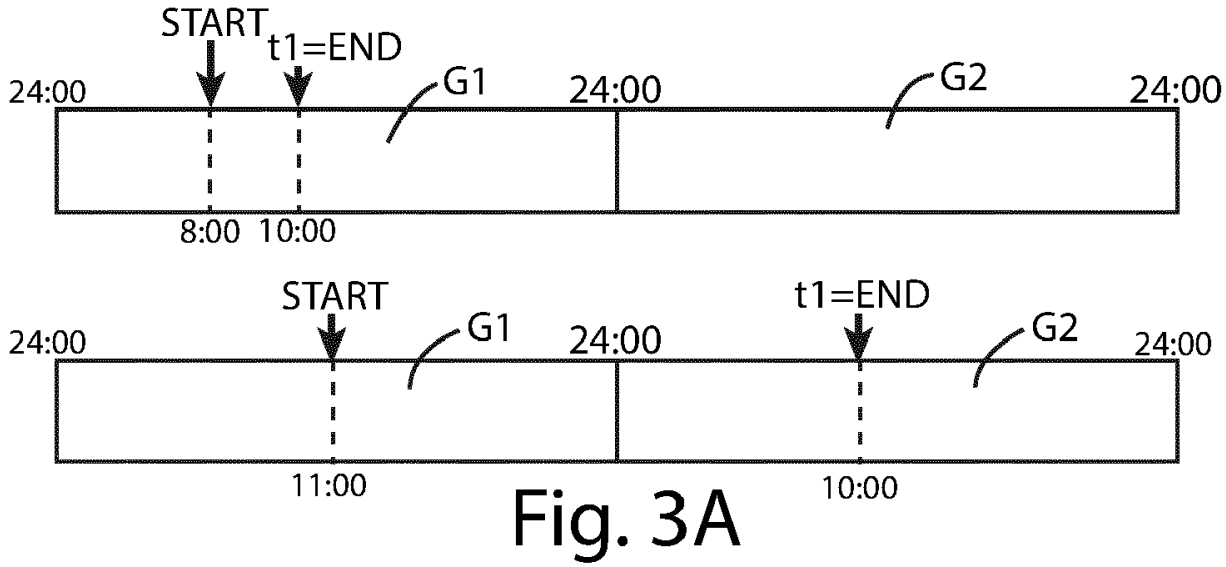


Fig. 3A

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## Description

**[0001]** This invention falls within the field of catering equipment, and relates generically to a device for the production of ice, which can be used for example in commercial establishments, such as bars, restaurants and the like.

**[0002]** More specifically, the invention relates to a device for the production of ice which is innovative and capable of producing ice in the quantities and times required by the user.

**[0003]** In fact, currently, the ice production devices on the market are capable of ensuring continuous ice production during a given period.

**[0004]** The duration of this period and, therefore, also the quantity of ice produced can be determined by the user, who may switch off the device after a certain period of time, or it may be the device itself, which, after detecting an excessive presence of ice in the storage tank, automatically stops the production.

**[0005]** Devices designed in this way have, however, some drawbacks. In fact, firstly, due to the tolerances of the refrigeration system components (compressor ageing, refrigerant gas leaks, etc.) and/or due to poor maintenance (dirty condenser), the ice production can change over time, usually worsening.

**[0006]** Moreover, since they cannot provide a variable amount of ice according to seasonal demand, a user may have insufficient ice available in some periods and too much at others.

**[0007]** Another consequence of the lack of programmability, both of the quantity of ice to be produced and of the required operating time, is the waste of energy and water for production of the ice, which, due to its deterioration or melting, cannot be used and will be discarded.

**[0008]** Moreover, even if the device could produce the desired amount of ice, the ice produced in this way would be of poor quality, having partly melted, as it was not produced near to the period of use.

**[0009]** Moreover, if production is not near to the use, the melting which occurs leads to a reduction in the amount of ice and consequently the loss of cooling capacity; the ice produced and partly melted corresponds to an energy loss which can reach levels on average more than 20% of the total. So as to limit these drawbacks and in order to absorb melt losses, the storage tanks and devices are generally oversized, increasing the energy requirements of the devices themselves and also increasing their dimensions and overall size.

**[0010]** Moreover, these inefficiencies have a greater impact on those activities which involve weekly closures; in fact, in order to avoid wasting energy, water and ice, the devices can be switched off, with the drawback, however, that when reopened, there will be no ice ready to be used.

**[0011]** The need therefore seems clear of having a device for the production of ice which is capable of supplying quantities of good quality ice, within predetermined timescales and which limit the waste of raw material and energy.

**[0012]** The main aim of the invention is, therefore, to overcome the above-mentioned drawbacks of the prior art, by means of a device for the production of ice, with the related process for the production of ice which can be implemented by such a device, which is able to limit the unnecessary or required consumption of energy and water and which is able to guarantee a predetermined quantity of ice at a predetermined time.

**[0013]** Another aim of the invention is to provide a device for the production of ice, which is programmable, by means of a process which can be executed by the device, in such a way that the end user can control both the quantity of ice to be produced after a certain period of time, and the operating time of the same device.

**[0014]** A further aim of the invention is to provide a device for the production of ice, providing good quality ice near to the use, minimising contamination of the ice by bacterial or other agents and allowing the production of a predetermined quantity of ice indicated by the user and/or made available at a predetermined time.

**[0015]** These and other aims are achieved by device for the production of ice, and the relative method for its use, according to the accompanying independent claims.

**[0016]** Further technical and detailed features of the invention are given in the accompanying dependent claims.

**[0017]** The invention will now be described, by way of example but without limiting the scope of the invention, according to some of its preferred embodiments and in particular with the help of the accompanying drawings, in which:

- Figure 1 schematically shows the operation of the device for the production of ice according to the invention by means of a first example of executable program;
- Figure 2 schematically shows the operation of the device for the production of ice according to the invention by means of a second example of executable program;
- Figures 3A and 3B show an example of parameter setting interfaces which can be displayed on the device according to the invention.

**[0018]** As already mentioned, the traditional machines, called ice producers, are usually able to supply a certain quantity of ice, in different quantities and shapes and within a defined time interval, depending on the production method, the type of ice produced, the cooling capacity developed and the ambient conditions.

**[0019]** In detail, according to the operation of these prior art machines, the ice is produced through successive cycles, including a first step of contact of the water, initially supplied in a liquid state, with a refrigerated surface (evaporator) where the water itself begins to solidify; when a threshold parameter is reached, which may be,

for example, the quantity or the shape of the cubes solidified on the surface or a temperature, a second step, so-called defrosting, occurs in which the surface is heated, to detach the ice. These machines may or may not be equipped with an ice storage facility and the reaching of a certain level of saturation of the storage facility currently stops the ice production, which resumes after it has been emptied. In order to manage the operation of these prior art machines there are electronic devices possibly combined with electromechanical components and/or pumps for the circulation and conveyance of water on the evaporator for the formation of the ice; obviously, due to use and/or poor maintenance, these machine components can deteriorate, worsening the energy efficiency and production capacity of the machines.

**[0020]** In order to overcome the above-mentioned drawbacks, the device according to the invention makes use of the electronic components normally installed and combined in the traditional machines, in order to efficiently manage the production of ice, by means of one or more control algorithms and relative executable programs, designed to produce a predetermined quantity of ice within a certain time; there may also be pumps and/or electromechanical components in general, as well as the possibility of installing various types of sensors (for example, capacity sensors in the ice storage tank, temperature sensors, etc.).

**[0021]** The algorithm according to the invention, in order for it to be executed, requires an initial input of data, which can be defined by the end user, by the manufacturer of the device and/or automatically estimated by the device itself during its use; clearly, in fact, the possibility to implement one or more algorithms and/or programs does not prevent the use of the device according to the invention in a conventional way, that is, starting production and waiting for the storage tank to fill with ice.

**[0022]** The data, corresponding to specific quantities, which the device according to the invention can use in the different programs, comprises:

- ice production per cycle (PMG), that is to say, the quantity by weight (for example, in kilograms or grams) of ice produced in an operating cycle, wherein a cycle comprises a first cooling step and a second defrosting step, as described above;
- the average time per production cycle (AVCY), that is to say, the average duration of a cycle, for example in hours, minutes and/or seconds, calculated automatically by the device using the data relative to the operation under working conditions; for example, it may happen that the ambient temperature is lower than the one assumed in the design phase, and, consequently, the average time per cycle will be shorter because it will be quicker for the device to cool the water;
- the standard cycle time (TMCY), that is to say, the standard duration of a cycle, for example in hours, minutes and/or seconds, defined by the manufacturer or the user, which is used for the calculations by the device in the absence of the average time per production cycle (AVCY) value, for example in case of a first use or if for some reason this data is lost or unavailable;
- the number of last production cycles (NCY), that is to say, the number of production cycles which the device uses to calculate the average time per production cycle (AVCY); this parameter does not intervene directly in the algorithm according to the invention, but only for the calculation of the average time per production cycle (AVCY).

**[0023]** Figure 1 shows a first example of an algorithm or operating program, which can be set using the control electronics installed inside the device according to the invention; this foresees the production of a predetermined quantity (usually by weight) of ice KG in the shortest possible time, starting from the moment this program is started.

**[0024]** For the execution of the program schematically shown in figure 1 it is sufficient to set, for example by means of a display installed on the device, the desired quantity of ice KG; the device itself will start the ice production process and pass to a standby state when the required quantity is reached or when the storage tank is filled.

**[0025]** In this case, starting from the set quantity of ice KG, the device calculates a number of cycles NC to be performed to obtain the required quantity of ice, by comparing the quantity to the value of ice production per cycle PMG, according to the formula NC = KG/PMG.

**[0026]** Clearly, since partial cycles cannot be performed, the number of cycles NC which the device performs is given by the value of the previous fraction rounded up to the next integer.

**[0027]** On the other hand, Figure 2 schematically shows an example of a program executable by the device according to the invention in which it is possible to produce a predetermined quantity of ice within a time limit, that is to say, within a certain date and time, which can be defined by the user.

**[0028]** In order to do this, the device calculates the time needed to produce the predetermined quantity of ice by weight KG and sets a time and date when the execution of the number of cycles NC needed to produce this quantity must start, in order to synchronise the end of the execution of the cycles NC needed with the time and date set by the user.

**[0029]** In this way, the required quantity of ice is available close to the moment when it is needed, avoiding the above mentioned drawbacks relative to the deterioration and/or melting of any ice which may be stored and excessive energy consumption.

**[0030]** The total production time Ttot needed to produce the required ice is therefore calculated from two factors:

- the first is the number of cycles NC calculated, as before, by dividing the quantity by weight of ice KG by the average ice production per cycle PMG;
- the second factor is chosen by the device itself alternately between two cycle time values corresponding to AVCY or TMCY.

**[0031]** In this respect, if, as described above, the device does not have available the AVCY value estimated on the basis of the number of the last production cycles (for example, in the case of a first start-up of the device), it will use the pre-set standard cycle time value TMCY as the cycle time.

**[0032]** In this case, the number of cycles NC is initially calculated using the ratio KG/PMG, rounding up the result to the next integer; consequently, the total production time Ttot will be obtained by multiplying the standard cycle time TMCY by the value NC rounded up and increased by one unit, to take into account tolerances and/or losses which may occur during the production (Ttot = (NC + 1)*TMCY).

**[0033]** The value of the total production time Ttot will indicate how much earlier, compared to the end of production date and time, the device must switch on and start producing ice.

**[0034]** If, on the other hand, the device has been in operation for a sufficient time or for a number of cycles at least equal to NCY and such that the average time for the production cycle AVCY can be calculated and/or estimated, then it will use the latter value for the calculation of the total production time Ttot. In this case, the calculation of the number of cycles to be performed does not change, whilst the calculation of the total production time Ttot becomes Ttot = (NC + 1)*AVCY, with the NC value rounded up.

**[0035]** In this way, the value Ttot will indicate the minimum time in advance, that is to say, how much time before the date and time of the end of production, the device must switch on and start producing ice to ensure the required quantity within the time and date initially set by the user.

**[0036]** At this point, the data of the quantity of ice to be produced KG and the date and time data when the ice to be ready, which are entered by the user, can be used by the device in two different ways.

**[0037]** According to the first method, defined as calendar setting, the user, after having set the quantity of ice by weight KG to be produced on the display of the device, can also directly set the desired date and time on the display, univocally defining the time when the required ice must be available. According to the second method, on the other hand, defined as a day setting and shown in Figures 3A and 3B, the user sets on the display of the device the quantity by weight KG, the desired time and a time interval, divided into 24-hour bands, in which this desired time falls, thus being able, for example, to choose between 24 hours, 48 hours or 72 hours after setting the parameters, so as to have the required ice available on the day immediately following the setting, after two days, or after three days.

**[0038]** Figure 3A shows an example of programming of a user which sets a quantity by weight of ice KG=3 and a time limit of 10:00 a.m., after having defined a time interval equal to 24 hours; depending on when the cycle starts (instant indicated with START in the drawings), the algorithm of the device takes as a reference for the end of the ice production (END) a first temporal instant t1 corresponding to the first time the time set by the user is met (which, in the case of the example shown in the attached drawings, are 10:00 a.m. of day G1 at the start of the cycle or 10:00 a.m. of day G2 after the start of the cycle, depending on whether the START instant is, respectively, before or after 10:00 a.m.).

**[0039]** Figure 3B, on the other hand, shows an example of programming which can be executed in a period of 72 hours; as can be seen, after having defined the period and the time, the device will take as an indication for the end of production of the ice the reference t1, that is to say, the third time it will meet the end of production time in days G3 or G4 after the start of cycle day G1. In both time programming methods, the device according to the invention will always check whether the time between the start of the ice production program and the end of production time is greater than the calculated total production time Ttot, that is to say, whether the time between the moment the program is started (START) and the moment t1 (END) is greater than the production time Ttot.

**[0040]** In fact, if this does not happen, it means that the device cannot produce the required amount of ice for the set time.

**[0041]** In this case, the device control board will signal that it is impossible to produce the quantity of ice in the required time and will ask to modify the quantity or the end of production time.

**[0042]** In another mode, after having set the quantity in weight KG, the program proposes, according to the parameters seen, the first time which guarantees the set production; this time can of course be increased and modified according to the real needs.

**[0043]** If there are no signals and the time between start-up and the set time is sufficient, the machine will produce the required ice and then pass to a stand-by condition.

**[0044]** It will also be possible to select the continuous operation option, in such a way that after the end of production time, the device can continue to produce ice.

**[0045]** At any time during the cycle and/or program, if the device detects a full tank signal through special sensors, the same device commands the end of the current cycle and goes into stand-by, stopping.

**[0046]** For further user convenience, it will be possible to store different production programs in the device electronics according to the invention, to facilitate the start of repetitive and periodic programs for the user.

**[0047]** The characteristics of the device for the production of ice and the relative method object clearly emerge

from the description, as do the advantages thereof:

- limitation of unnecessary energy and water consumption;
- guaranteeing to provide a predetermined quantity of ice at a certain time;
- guaranteeing to provide good quality ice, near to the use;
- increased energy efficiency and production;
- reduction of ice contamination;
- reduction of overall dimensions of ice deposits or machines.

**[0048]** Lastly, it is clear that the invention has been described by way of example only, without limiting the scope of application, according to its preferred embodiments, but it shall be understood that variations and/or modifications may be made to the invention by experts in the field, without thereby departing from the relative scope of protection of the accompanying claims.

**Claims**

1. Ice production method, executable by an ice production device, comprising the following successive phases:

   a) setting by a user of a quantity in weight of ice (KG) to be produced;
   b) doing a ratio between said quantity in weight of ice (KG) to be produced and a value of average ice production (PMG) per cycle, obtaining a value of number of cycles (NC) necessary to produce said quantity in weight of ice (KG), wherein said average ice production (PMG) is the quantity in weight of ice which can be produced on average in every operation cycle of said device;
   c) rounding up said number of cycles (NC) value to a rounded up number of cycles value corresponding to an immediately next integer value;
   d) execution by said device of a number of operation cycles equal to said rounded up value of number of cycles.

2. Method according to claim 1, **characterized in that** said phase a) comprises the following operation:

   a1) definition by said user of a first time instant (t1), correspondent to a date and/or an hour, at which the production of said quantity in weight of ice (KG) carried out by said device is made available and said execution of the operation cycles number of the device is stopped, so that said device switches to a stand-by condition.

3. Method according to claim 1, **characterized in that** after said phase c) the following successive phases are carried out:

   c1) increase said rounded up value of number of cycles by one unit;
   c2) multiplication of a cycle time value by said value of number of cycles rounded up and increased by one unit as previously obtained, to obtain a value of total production time (Ttot) during which said device is capable of producing said quantity in weight of ice (KG).

4. Method according to claim 3, **characterized in that** said cycle time value is alternatively equal to:

   - a production cycle average time (AVCY), that is an average time duration of a cycle calculated by said device, for example in hours, minutes and/or seconds;
   - a standard cycle time (TMCY), that is a standard time duration of a cycle previously defined for said device, for example in hours, minutes and/or seconds;

5. Method according to claim 2, **characterized in that** said user defines if said first time instant (t1), correspondent to a date and/or to a time on which the production of said quantity in weight of ice (KG) is made available, is expected in the 24, 48 or 72 hours following the moment at which said execution of the number of operation cycle of said device starts.

6. Method according to at least one of the previous claims, **characterized in that** said device includes first alarming means if a time interval comprised between the start of the execution of the operation cycle number and the end of said execution is greater than said calculated total production (Ttot) time.

7. Method according to at least one of the previous claims, **characterized in that** said device includes second alarming means and automatic stopping means of said operation cycle execution if sensor means of said device signal a condition according to which an ice storage container of said device is full to a preset level or quantity.

8. Method according to at least one of the previous claims, **characterized in that** said device includes memorization means to store in a memory recurring and periodic production programs.

9. Device for the production of ice suitable to execute a method for the production of ice according to at least one of the preceding claims.

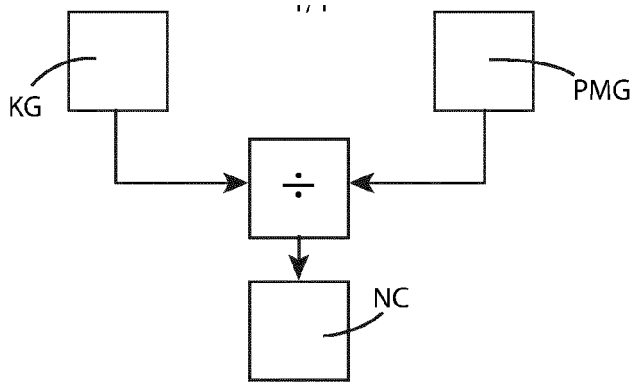


Fig. 1

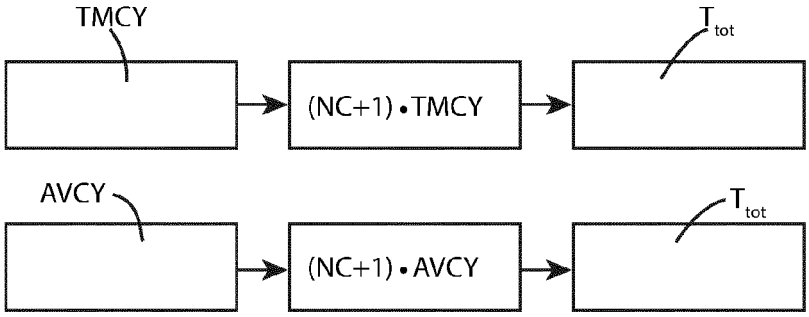


Fig. 2

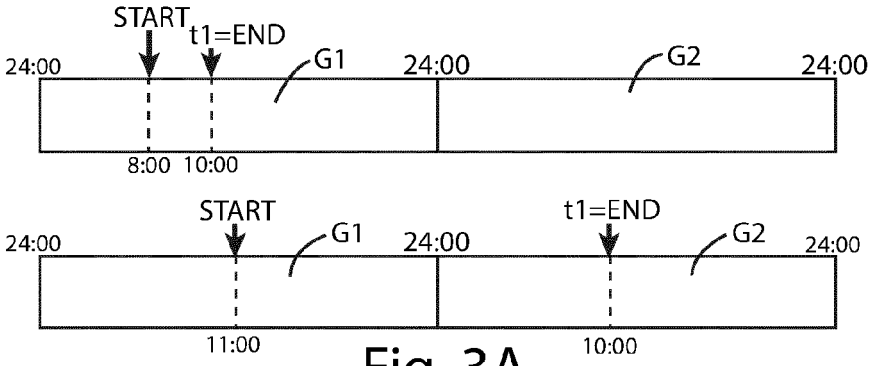


Fig. 3A

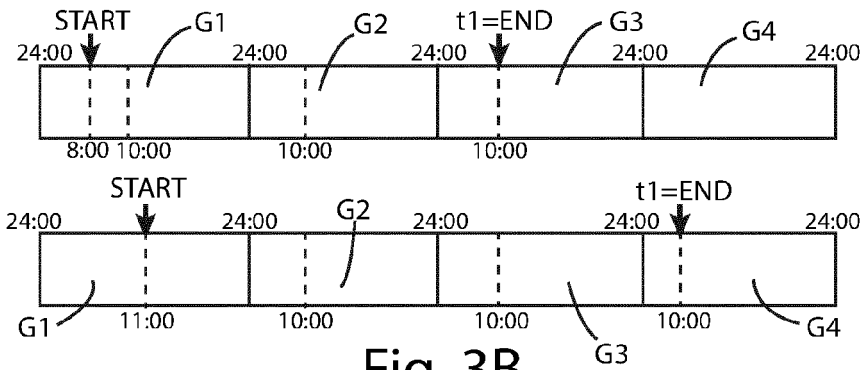


Fig. 3B

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# EUROPEAN SEARCH REPORT

Application Number
EP 20 18 8850

## 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 2018/164016 A1 (OH SEOUNG HUN [KR]) 14 June 2018 (2018-06-14) * paragraphs [0049], [0050]; figure 1 * | 1-9 | INV. F25C1/00 G06Q10/04 |
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TECHNICAL FIELDS SEARCHED (IPC)

F25C
F25D
G06Q

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 11 January 2021 | Vigilante, Marco |

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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 18 8850

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