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ICE PRODUCTION MACHINE WITH ELECTROMECHANICAL PERIPHERAL APPARATUS AND AUTOMATIC WASHING CONTROL ELECTRONIC DEVICE

(57)

The invention relates to a machine for producing ice cubes or the like, wherein ice is formed by spraying water onto the evaporator (24) of a refrigerator assembly (20).

The machine is equipped with an electronic programming device (40) operationally connected to the refriger-

ator assembly (20) and to the water spraying means (32, 33, 34, 35), so that it can control the operation thereof. The machine can also carry out a washing step by spraying wash liquids onto the evaporator, which liquids are manually poured into the ice formation tray.

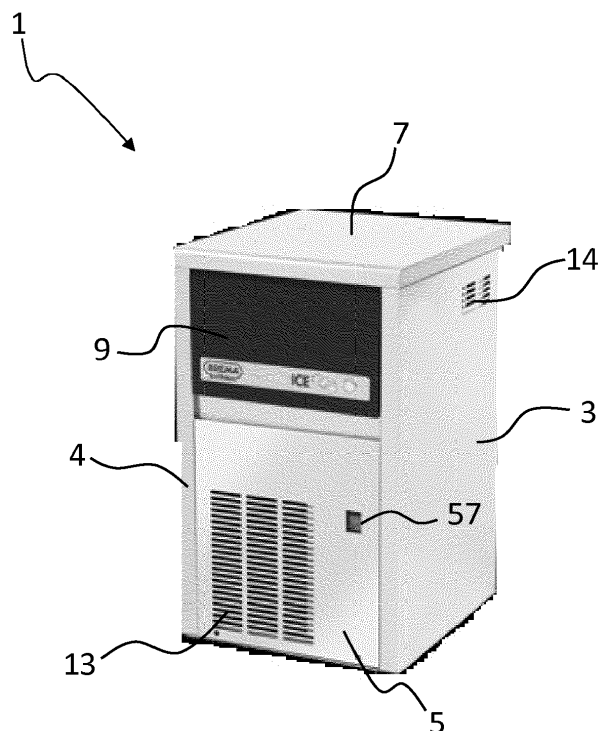


Fig. 1

Description

[0001] The present invention relates, in a more general aspect thereof, to machines for ice production, wherein the term "ice" means mainly, but not only, so-called ice cubes, i.e. those pieces of ice, not necessarily exactly cubical in shape but suitable for being placed into glasses, jugs and other similar beverage containers.

[0002] Therefore, the invention is also applicable to ice pieces having a truncated-pyramid, conical, spherical, lobed or complex shape or any other geometrical and/or patterned configuration, whether solid or hollow. However, for brevity's sake, in the following description the term "cube" will mostly be used, though it should not be deemed limited to a particular cubical geometrical shape but, in fact, it will apply to all configurations mentioned above.

[0003] Machines for producing ice cubes have been known for a long time and are also simply referred to as producers by those skilled in the art; in substance, they are refrigerating machines carrying out a typical refrigeration cycle by exploiting the thermodynamic properties of compressible fluids, which can evaporate or liquefy when certain conditions of temperature and pressure are met.

[0004] For this reason, the machines are equipped with a circuit wherein a refrigerating fluid circulates (e.g. pentafluoroethane, trifluoroethane and/or mixtures thereof, designated in the ASHRAE classification as R125, R143, R134, R404, or other fluids with R.n classification), which is processed by a compressor assembly before flowing into a condenser, where it cools down by exchanging heat with the outside environment, and finally arrives at an evaporator, where the water on it is cooled to form the desired ice.

[0005] To this end, the evaporator usually consists of a plate or the like, wherein the refrigerating fluid circulates, and the walls of which are configured with the profile of the ice pieces to be produced, e.g. cells, ribs, grooves or the like.

[0006] Water is sprayed, through suitable nozzles, onto the evaporator plate, which water then freezes in a short time, thus forming the cubes; the latter are then removed from the evaporator by gravity, after a defrosting step carried out by diverting the refrigerating fluid directly towards the evaporator, i.e. bypassing the condenser.

[0007] For this purpose, the refrigerating circuit typically includes control valves for pressure control and/or fluid interception, as well as timer means for controlling the operation of such valves in accordance with the various steps of the working cycle.

[0008] As aforesaid, circulation of the refrigerating fluid between the evaporator and the condenser is ensured by a compressor, which is used for having the fluid to go from a lower pressure in the evaporator to a higher pressure in the condenser; the compressor has an on/off type of operation and is activated by the ice request.

[0009] Indeed, ice is preserved in a thermally insulated

compartment of the machine and when it reaches a pre-defined level, the compressor is switched off by a thermostat and ice production stops; vice versa, the compressor is switched on when ice production is requested.

[0010] For increased productivity, the machines may be equipped with multiple evaporators or a multi-section evaporator, so that the ice cubes formed on one evaporator (or one section thereof) can be dropped while in another evaporator other ice cubes are being formed by cooling the water.

[0011] Machines for ice production having these characteristics are known in the art and ensure good levels of efficiency and reliability; as an example thereof, reference can be made to European patent application EP 2 053 323, or to the machines manufactured by the present Applicant.

[0012] However, aiming to improve the current technology, the present Applicant has determined a number of possible areas of intervention: one of these is the machine cleaning.

[0013] Indeed, as can be easily guessed, the machines need to be periodically cleaned and sanitized in order to prevent or limit the formation of lime deposits and the like, which would otherwise cause the presence of pathogenic germs or anyway of impurities on the surface of the evaporator, which might alter the quality of the ice cubes.

[0014] For this reason, the machines are periodically washed, preferably by using suitable products such as detergents, disinfectants and the like; this operation is carried out manually by an operator, who cleans the surfaces by using sponges, cloths or similar means.

[0015] Although this traditional way of cleaning is effective, it is inevitably dependent on the human factor, and therefore it is often irregular, since the operator may not always be the same, or the same person may work differently from time to time.

[0016] Moreover, the time intervals at which the cleaning is carried out may be irregular as well; for example, it may happen that the cleaning cycle is carried out earlier or later than planned for the periodic maintenance of a machine.

[0017] In this respect, it must be taken into account that the machines considered herein are mainly intended for professional use in restaurants, pubs, public places or the like; therefore, there may be days when the personnel cannot or do not have the time to clean the machine, e.g. because they are busy in other tasks.

[0018] It follows that a need is felt in the art for avoiding such situations.

[0019] In light of the above analysis, it can be stated that a technical problem underlying of the present invention is to provide a machine for producing ice cubes, which has such structural and/or operating features as to overcome the above-mentioned limitations.

[0020] From a general point of view, the idea for solving this problem is to provide a machine equipped with additional functions, besides producing ice cubes, so that

it can meet other requirements such as evaporator cleaning or the like; preferably, this must not be detrimental to the structure and/or complexity of the machine.

[0021] From a more specific point of view, the idea for solving the above-mentioned technical problem is to exploit the nozzles used for spraying water for forming ice also for washing the evaporator: in this manner, the structure of the machine remains essentially unchanged, but it can perform additional functions and offer improved performance.

[0022] The features of the invention will be more specifically set out in the claims appended to this description; they will become more apparent in the light of a preferred but non-limiting embodiment thereof, which will be described below by way of non-limiting example with reference to the annexed drawings, wherein:

- Fig. 1 and 2 are, respectively, front and rear perspective views of an ice production machine in accordance with the invention;
- Fig. 3 is a view of the aforesaid machine with a part removed, to make the inside thereof visible;
- Fig. 4 is a sectional view of a detail of the machine of the preceding figures;
- Fig. 5 shows an ice slide plate of the machine of the preceding figures;
- Fig. 6 shows a programming device of the machine of the preceding figures;
- Fig. 7 is an electric diagram of the above machine;
- Fig. 8 is a block diagram of the programming device of Fig. 6;
- Fig. 9 is a block diagram of the refrigerator assembly of the above machine;
- Fig. 10 is an electric diagram of a variant of the above machine.

[0023] With reference to the above-listed drawings, numeral 1 designates as a whole a machine for producing ice cubes according to the invention, which comprises a substantially parallelepiped external structure 2, basically consisting of a thermally insulating cabinet, with side walls 3, 4, a front wall 5, a rear wall 6, a top wall 7.

[0024] As can be seen, on the front wall 5 there is an opening 9 with a diaphragm or closing element 10 consisting of a door, a curtain or other similar component, which is adapted to close the opening 9 and prevent thermal dispersion towards the outside through it, while at the same time allowing access to the inside of the machine 1 for removing the ice.

[0025] On the front wall 5, rear wall 6 and side wall 3 there are also air vents 13, 14, 15 for air circulation, protected by grids or fins; the shape and dimensions of the vents may depend on several factors, including the size and power of the machine, whether it is an air-cooled or water-cooled machine, etc.

[0026] The structure 2 internally houses a refrigerator assembly 20 with a compressor 21, a condenser 22, an expansion unit 23 and an evaporator 24; optionally, a

tank S for the refrigerating fluid may also be included, especially in quite big machines.

[0027] The upper region of the machine 1 accommodates the ice-forming part that comprises the evaporator 24, which is advantageously configured as a mould comprising cells or seats 25 for forming ice cubes.

[0028] The evaporator 24 is arranged under the top wall 7 of the structure 2; underneath the evaporator there is a plate 29 for discharging the ice cubes; this plate is used as a chute for delivering the cubes falling from the evaporator 24 towards a containment drawer or vessel 30, from which they can be removed by a user, who can gain access to it through the front opening 10 of the structure.

[0029] The plate 29 may have any appropriate design, though it is preferably of the type described in European patent application EP2584292 by the present Applicant, shown in Figure 5.

[0030] For more details, reference should be made to said patent application; however, it is worth mentioning herein that the slide plate 29 is equipped with nozzles 32 that, during the ice production cycle, spray water onto the evaporator 24.

[0031] For this purpose, the nozzles 32 are fed by a pump 33 that takes water from a tub 34 and delivers it to the nozzles via a delivery header 35.

[0032] In the machine 1 for ice production, a fast defrosting cycle of the evaporator 24 is carried out by circulating therein, the hot refrigerating fluid exiting the compressor 21; to this end, the refrigerator assembly 20 includes a recirculation branch 26 (indicated by a dashed line in Figure 8), which extends from an electrovalve 27 arranged downstream of the compressor 21 up to the evaporator 24, so that in the latter a fraction of hot compressed fluid will circulate, thereby causing the ice to melt locally in the cells and to detach, dropping by gravity onto the plate 29 which will then divert it towards the container 30.

[0033] In accordance with a preferred embodiment of the invention, the operation of the machine 1 for ice production is governed by a programming device 40 to which the various components of the machine are different, including also, further to those taken into consideration so far, sensors and/or thermostats and or electrovalves, as shown in the diagram of Figure 7.

[0034] The device 40 is essentially an electric controller, which may be appropriately designed as a function of the complexity of the machine 1 and of the operation thereof, as will be explained below.

[0035] It comprises electronic components that are *per se* known, such as a processor 45 (CPU) associated with a primary memory 47 (RAM) and a mass memory 46 (ROM), one or more analog-to-digital converters 48 (A/D), an interface 49 for the machine components (compressor 21, electrovalve 27, temperature sensors 28, water pump 33, etc.), a communication interface 50 (SCI, Serial Communication Interface, or the like) for connecting the programming device 40 with the outside, prefer-

ably via an infrared, Bluetooth, Wi-Fi port or another electromagnetic-wave system, so that data can be exchanged (i.e. received and sent) with external apparatus such as electronic computers, whether fixed like a PC or portable like, for example, a tablet, as well as with other devices, including smartphones and data transmission networks (WAN, LAN, etc.).

[0036] Preferably, the components of the programming device 40 are operationally connected to one another via a bus 51 and are electrically powered by the electric system 52 of the machine; the programming device 40 may however be powered separately from the machine 1, possibly by batteries, so that it will be structurally and functionally independent.

[0037] Indeed, although the programming device 40 is preferably housed inside the structure 2 of the machine for ice production, it may however be installed outside the structure 2, in the rear part thereof, as visible in Figure 2, in which case, of course, it will have to be wired to the other components of the machine 1.

[0038] The latter operates as described below; in this regard, it must be said beforehand that the programming device 40 allows the execution of different operating cycles of the machine by fully exploiting the components thereof not only for ice production, but also for other functions, such as automatic wash management and machine state checking, thus improving the overall performance.

[0039] The device provides immediate visual information about the producer's state (by means of LEDs or icons or other on-screen signals, not shown in the drawing), and simplifies the commands for maintaining the machine (pushbutton for automatic washing and defrosting).

[0040] One of the configurations that the device may have is the following:

- ON/OFF button: turning on/ off the producer (green LED);
- Defrost button: defrosts the producer (yellow LED);
- Wash button: this button allows entering/exiting the automatic wash cycle (blue LED).

[0041] When the producer is first started by pressing the ON/OFF button, the green LED will blink for a preset time (approx. 3 minutes). During this time interval, water is supplied into the internal tray, where ice will be produced.

[0042] Without the present invention, this task would be carried out manually by the operator by pouring water from the front part of the internal cell or by manually forcing the defrosting step, during which also the water level for ice production is restored.

[0043] Once started, the machine 1 acquires the temperature (T_{Box} in the diagram of Figure 7) in the ice container 30: if the latter is full of ice cubes, its temperature will be low (around 0 °C) and the switch 55 will be opened by the programming device 40; in this condition,

the compressor 21 will be off and no water will be sprayed onto the evaporator 24.

[0044] The machine 1 will remain in this condition until the temperature inside the ice container 30 reaches a predefined level; the switch 55 will then close the circuit to start the compressor 21 and the water pump 33 that feeds the nozzles 32.

[0045] Ice will form in the moulds 25 of the evaporator 24, cooled by the fluid circulating in the refrigerator assembly; the system will remain in this state until ice cubes have completely formed on the moulds 25: this may occur after a time interval set by the programmer 40, or when a certain defrost temperature is reached on the evaporator 24 (T_{Defr} in Figure 7), detected by a switching thermostat 56 similar to the thermostatic switch 55.

[0046] At this point the electrovalve 27 will be turned on, and the hot fluid exiting the compressor 21, or at least a part thereof, will be diverted into the recirculation branch 26 and will enter again the evaporator 24, thus warming it up and causing the ice to thaw locally and the ice cubes to drop from the moulds 25.

[0047] The above-described cycle is repeated until the level of the ice cubes in the container 30 is restored and the temperature therein returns to a predefined value (T_{Box}), after which the switch 55 will open and stop ice production.

[0048] As can be seen, as far as ice production is concerned, the programming device 40 can perform those functions that, in prior-art machines, are governed by electromechanical timers, which are essentially cam-type mechanisms.

[0049] Unlike the latters, however, the device 40 ensures better efficacy and accuracy because it controls the operation of the various components of the machine, not (only) on the basis of preset time intervals, but according to process parameters detected in operation.

[0050] This is the case, for example, of the temperatures (T_{Box} , T_{Defr}) of the ice container 30 and for defrosting the evaporator 24, which may be reached differently from time to time; for example, let us consider the different conditions in which a machine will have to work in summer and in winter: the different temperatures will affect the ice production cycle and the time needed for filling the container 30.

[0051] The possibility of controlling the operation of the machine also according to such temperatures, allows adapting the production process to the actual environmental conditions.

[0052] Furthermore, under an operating viewpoint, the programming device 40 offers higher flexibility in controlling the operation of the machine 1, thereby improving the performance thereof.

[0053] Indeed, the device 40 can be programmed in such a way as to carry out specific cycles as regards both ice production and maintenance and/or control of the machine 1.

[0054] As far as the former aspect is concerned, it is clear that the processor 45, the memories 46, 47 and the

other electronic components make it possible to store different machine management programs that will cause it to work as desired.

[0055] For example, in addition to the above observations about the temperature conditions in which the machine 1 may have to operate, it must be pointed out that the working cycles may have different durations depending on the machines' productivity.

[0056] The same applies to different ice cubes, the shapes and dimensions of which can affect the above-described production process, requiring different cooling times and/or heat; likewise, the hourly amount of ice to be produced may vary among different machines.

[0057] However, in all such cases the programming device 40 is still the same: what changes is the programming thereof, which is adapted according to specific requirements. The programs are loaded into the memory 46, 47 via the communication interface 50.

[0058] They may however reside in such memories and/or in the processor 45, depending on the design and electronic architecture chosen for the programmer 40.

[0059] Furthermore, according to a preferred embodiment, the data about the operation of the machine, such as duration and/or number of ice production cycles, temperature trend in the container 30 and of the refrigerating fluid, activation times of the compressor 21 and, more in general, of the refrigerator assembly 20, as well as any other parameters of the machine 1 (e.g. power consumption, refrigeration cycle pressures, etc.) are kept in the memories 46, 47, so that they can be used for controlling and/or servicing the machine.

[0060] Transmission and receiving of the data acquired by or stored in programming device 40 occur by means of its communication interface 50, preferably via electromagnetic-wave transmission, such as infrared or radio frequency (e.g. Bluetooth, Wi Fi and the like); of course, other systems may also be used, such as, for example, a wired connection between the programmer 40 and a computer, or a USB port for connecting external storage means (e.g. pen drives, memory cards, hard disks, etc.) where to the data can be downloaded and then transferred as desired.

[0061] Alongside these functions, the programming device 40 can also have the machine 1 carry out other operations, in addition to ice production.

[0062] This is the case, for example, of the step of checking the operating state, which is activated when the machine is in operation by holding down the master on/off button 57 for a time interval of a few seconds, preferably 5 to 10 seconds.

[0063] If the button is pressed for a time shorter than this interval, the machine will be normally turned off; the start of this special function of the machine is preferably accompanied by a luminous signal, e.g. one or more lamps of the machine blinking simultaneously, or by an audible signal.

[0064] Regardless of the signalling mode, when this step of pressing the button 57 has been completed and

the special machine check function has been started, the machine will take a specific reference configuration that may correspond to one of those adopted during ice production, during which the electric connections are checked.

[0065] It will thus be possible to verify, both during industrial production of the machines 1 and *in situ* on machines installed at customers' sites, the electric features of both the machine and the programmer 40 by means of an automatic test, during which the machine 1 will be turned on and off in order to test its efficiency.

[0066] After the machine has been turned off automatically, if the test ended successfully the machine 1 will restart automatically (i.e. without requiring pressing the on/ off button 57) and will work regularly for ice production, as previously explained.

[0067] The programming device also allows the execution of other functions of the machine 1 for ice production, in addition or as an alternative to those already described; one of such functions concerns the washing of the evaporator 24.

[0068] In fact, the periodic maintenance of ice-producing machines includes cleaning those parts where ice cubes are formed, i.e. the moulds of the evaporator, in order to remove any lime deposits or fouling in general, which may cause the presence of dirt or germs and reduce the quality of the ice being produced.

[0069] This maintenance step is usually carried out manually by an operator, who uses cloths and detergents for cleaning the surfaces involved.

[0070] In order to overcome these drawbacks, according to a preferred embodiment of the invention the illustrated device teaches to carry out operations for washing the evaporator 24 by spraying onto it, through the nozzles 32, water containing sanitizing and or cleaning substances, such as chlorine, soap, decalcifier and the like.

[0071] This allows cleaning the moulds 25 for the ice cubes and also the nozzles 32 and all the other parts of the hydraulic circuit, such as the pump 33 and the tub 34, thus keeping the whole machine 1 efficient, the latter remaining in operation during the washing.

[0072] During this step, the programming device 40 stops the compressor 21 but allows the pump 33 and the other components of the hydraulic circuit (e.g. water inlet and drain valves, not shown in the drawings, etc.) to operate.

[0073] Of course, also the washing of the machine 1 can be executed in accordance with different programs stored in the programming device 40; for example, more or less intense programs may be available, with different durations and/or number of cycles of treatment with detergent, disinfectant, decalcifying watery solutions, which may vary as necessary.

[0074] Of course, the invention may be subject to a number of variations with respect to the description provided so far.

[0075] First of all, it must be pointed out that the programming device 40 may be designed in a different man-

ner, e.g. with integrated components, so as to have smaller dimensions.

[0076] Likewise, also other special functions, in addition to the check of the efficiency of the machine components and to the washing function, may be governed by the programmer 40; for example, these may include checking the energetic efficiency of the machine on the basis of the amount of ice produced (and therefore of the refrigeration units necessary for subtracting solidifying heat) and of the electric power absorbed by the refrigerator assembly.

[0077] Another variant can be obtained when the condenser 22 is water cooled; in such a case, the air exchanger will be replaced in the machine with a water exchanger fed with mains water, possibly after the latter has been used for the ice.

[0078] According to a preferred embodiment, of which Figure 10 shows an electric diagram, there is a further thermostatic switch 59 connected in series to the master defrosting switch T_Defr.

[0079] When the switch 59 is triggered, the machine 1 will enter a state in which it will wait for the temperature of the condenser 22 to be restored, similar to the state in which the machine waits for restoral of the temperature of the ice container 30.

[0080] Further possible variants concern the nozzles 32, which, as aforesaid, are preferably made in this example in accordance with the description provided in patent application EP 2 053 323 by the present Applicant: this allows them, in fact, to be coplanar to the chute wall 29, thus facilitating the motion of the cubes towards the container 30.

[0081] It is however apparent that other configurations are also possible for both the nozzles 32 and the walls 39, such as, for example, those known in the art: what is important is, however, that the nozzles are adapted to spray water onto the evaporator not only for forming ice, but also for cleaning the evaporator in accordance with the teaching of the invention.

[0082] These and other equivalent variants will still fall within the scope of the following claims.

Claims

1. Machine for production of ice cubes and the like, comprising a refrigerator assembly (20) including at least one evaporator (24), means (32, 33, 34, 35) for supplying water to said at least one evaporator (24) for forming ice, **characterized in that** it comprises an electronic programming device (40) operationally connected to the refrigerator assembly (20) and to the water supply means (32, 33, 34, 35), thereby controlling the operation thereof.
2. Machine according to claim 1, wherein the programming device (40) is adapted to check the state of the refrigerator assembly (20) and/or of the water supply

means (32, 33, 34, 35) when the machine is started.

3. Machine according to claims 1 or 2, comprising user-operated starting means (57) for starting it, wherein a step of checking the state of the refrigerator assembly (20) and/or of the water supply means (32, 33, 34, 35) is started via said starting means (57).
4. Machine according to any one of the preceding claims, wherein the programming device (40) is adapted to carry out a cleaning step, during which the supply means (32, 33, 34, 35) spray a liquid onto the evaporator (24) for washing it.
5. Machine according to claim 4, wherein during the washing step the refrigerator assembly (20), or at least the compressor thereof (21), is substantially inactive.
6. Machine according to any one of the preceding claims, comprising a container (30) into which the ice cubes are collected, and wherein the programming device (40) controls the activation and/or deactivation of the refrigerator assembly (20) as a function of the temperature detected in the container (30).
7. Machine according to any one of the preceding claims, wherein the refrigerator assembly (20) comprises a water-cooled condenser (22) and means for supplying water to said condenser (22), which are operationally connected to the programming device (40).
8. Machine according to claim 7, wherein the means for supplying water to said condenser (22) comprise at least a part of those (32, 33, 34, 35) for supplying water to the evaporator (24).
9. Machine according to any one of the preceding claims, wherein the programming device (40) is adapted to transmit and/or receive data relating to at least one of the following operating parameters: operating time, temperature of an ice collection container (30), defrosting temperature of the evaporator (24), temperature of the cooling water of the condenser (22), quantity of ice produced, electric power absorbed by the refrigerator assembly (20).
10. Method for washing a machine according to any one of the preceding claims, comprising at least one step of cleaning the evaporator (24), **characterized in that** said cleaning step is at least partly carried out by spraying a liquid onto the evaporator (24) through the means (32, 33, 34, 35) for supplying water to said at least one evaporator (24) for forming ice.

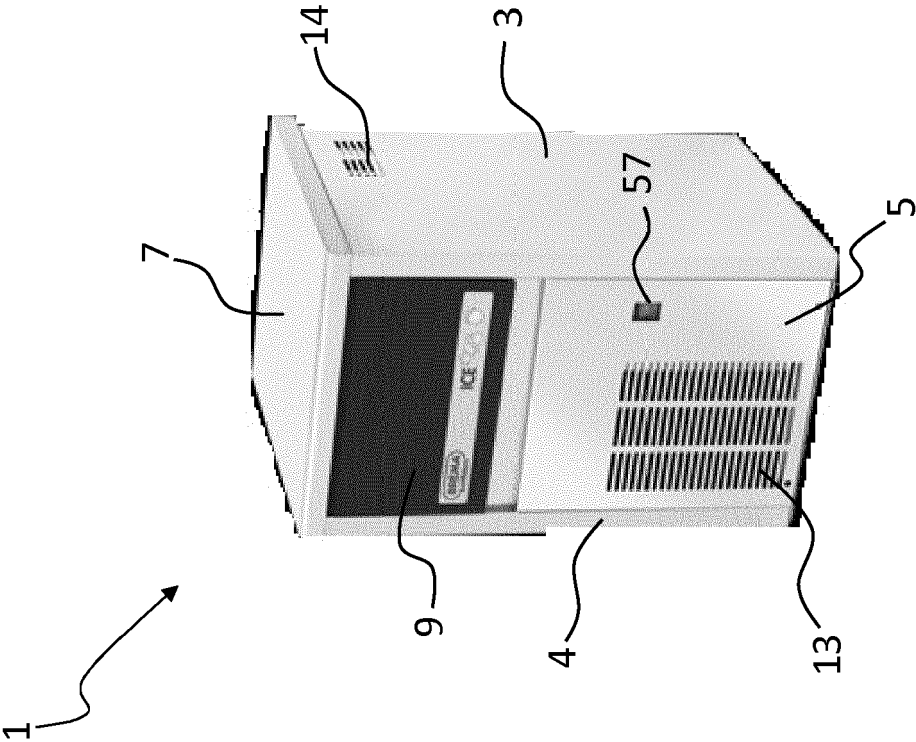


Fig. 1

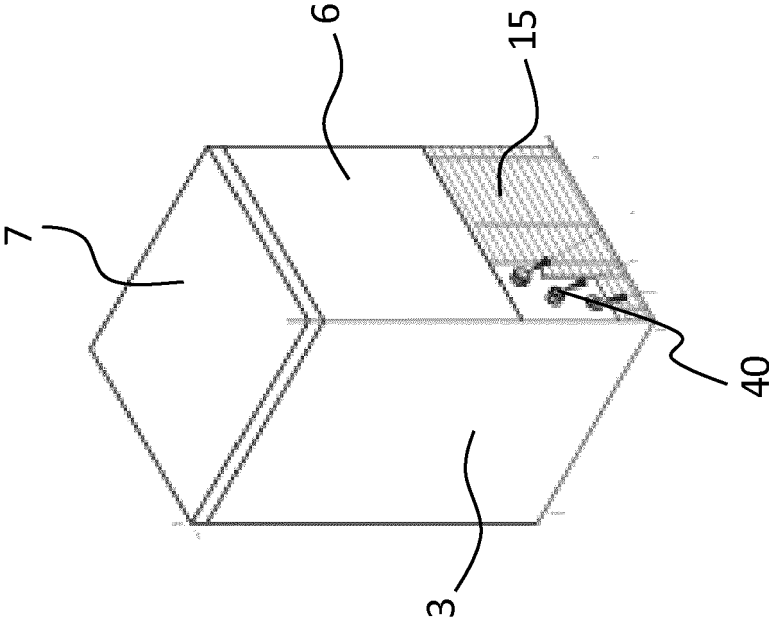


Fig. 2

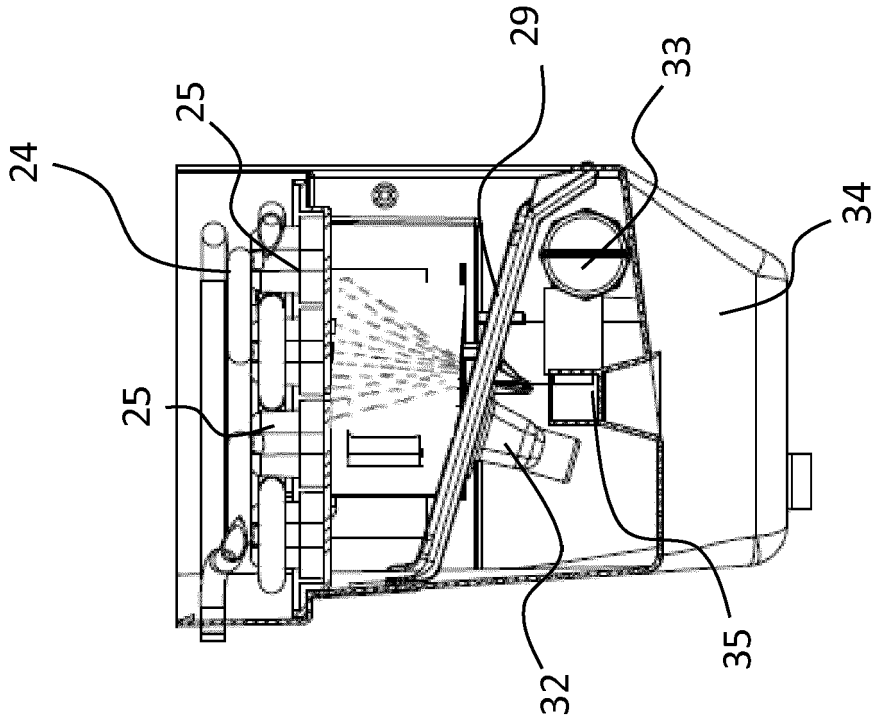


Fig. 4

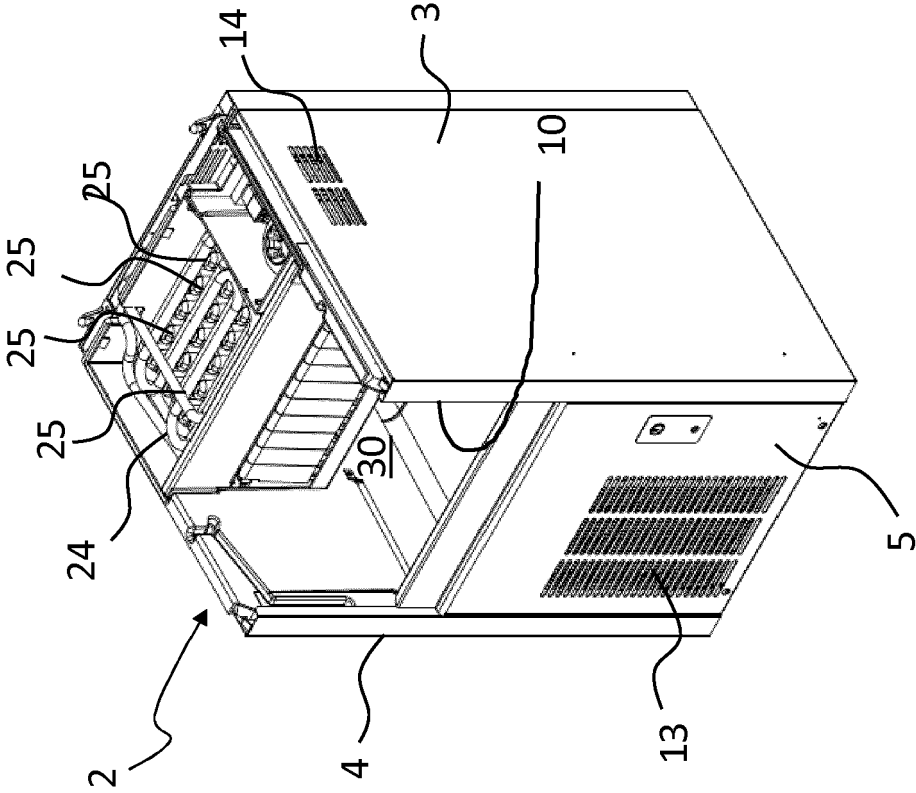


Fig. 3

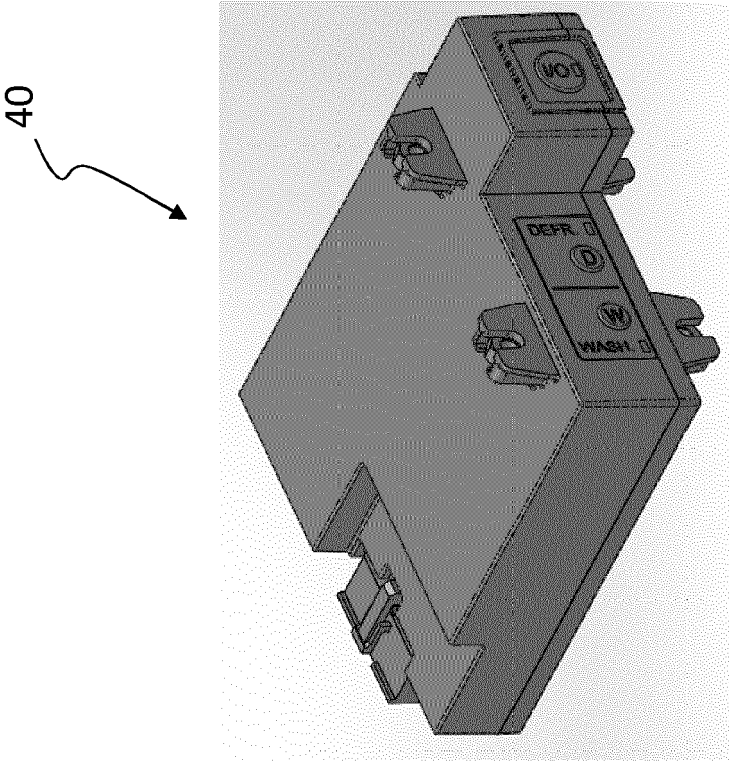


Fig. 6

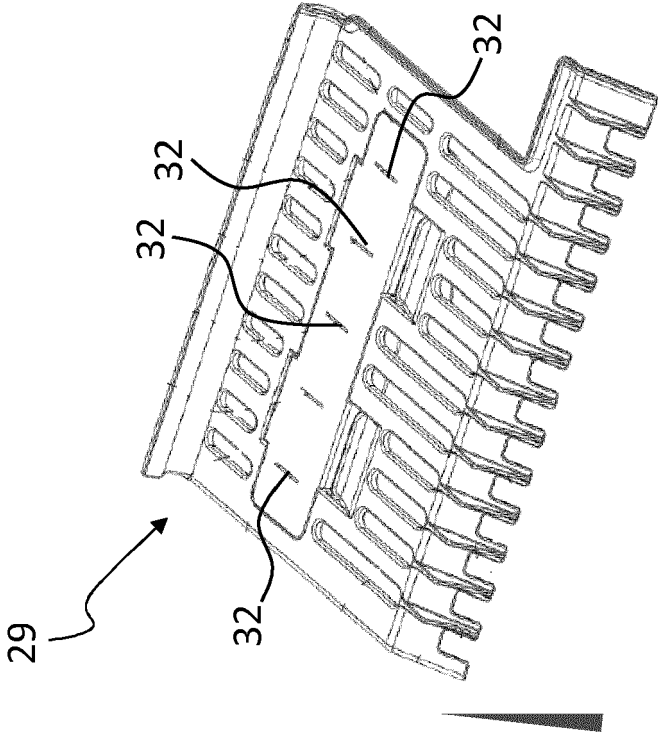


Fig. 5

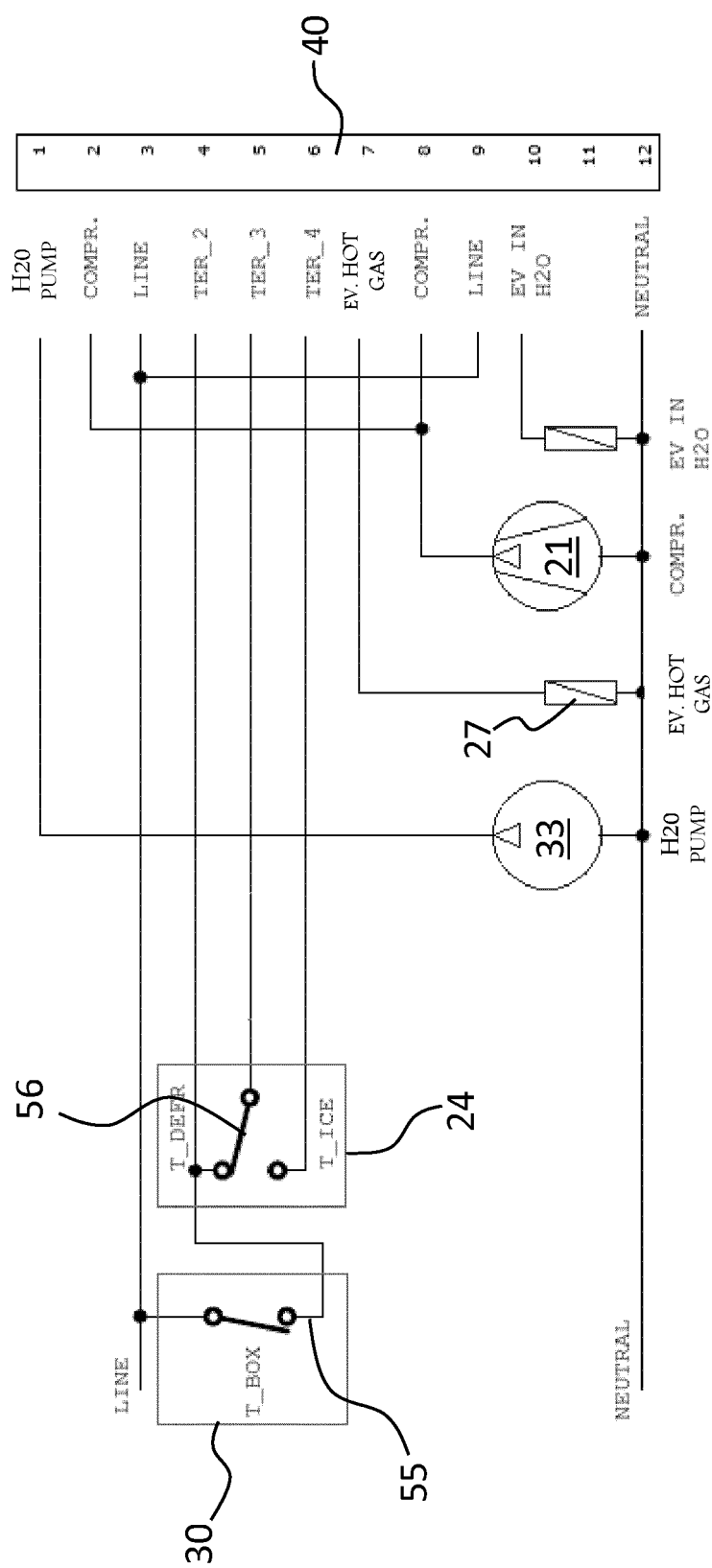


Fig. 7

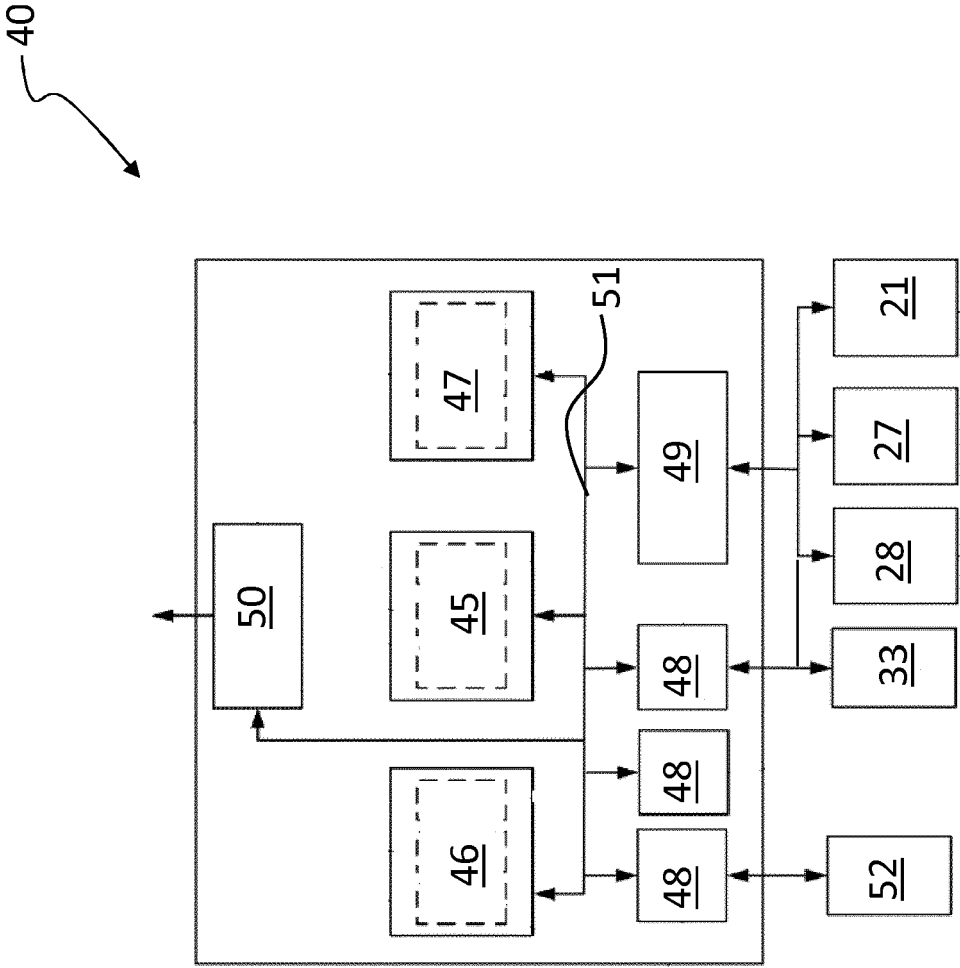


Fig. 8

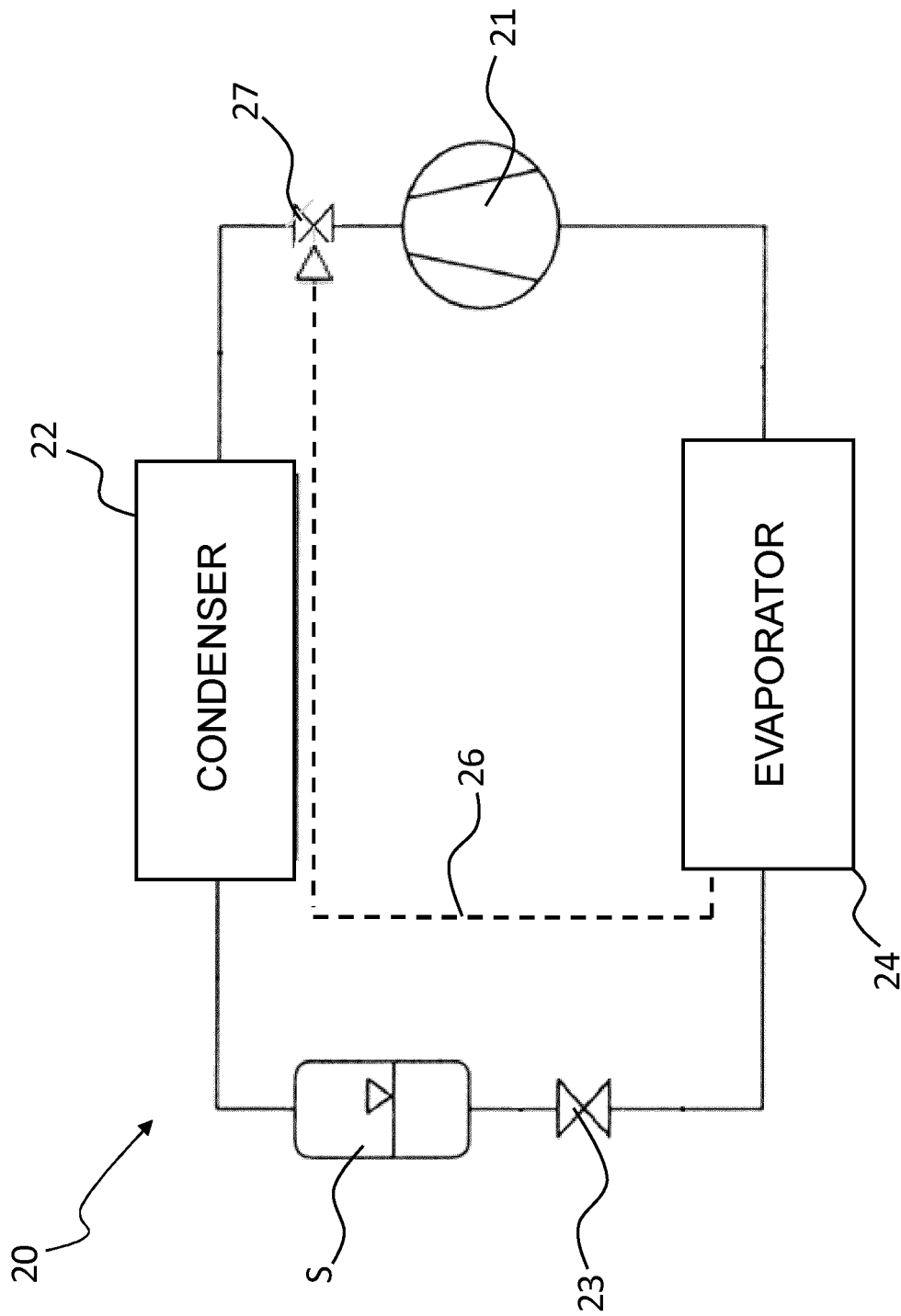


Fig. 9

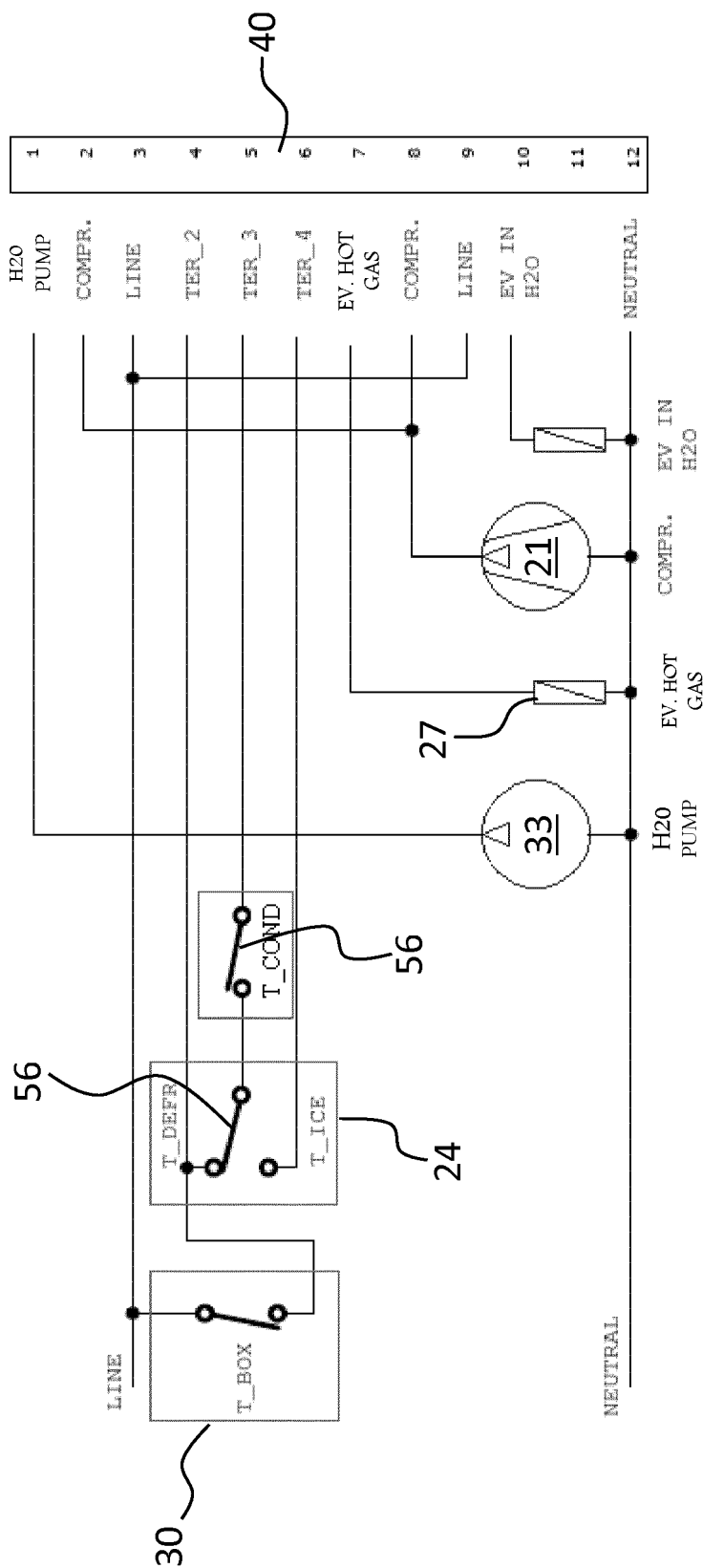


Fig. 10



EUROPEAN SEARCH REPORT

Application Number
EP 16 42 5020

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	US 2014/013781 A1 (ANTOINE THOMAS H [US] ET AL) 16 January 2014 (2014-01-16) * paragraph [0032]; figures 1-2 *	1-3	
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X	US 2008/092567 A1 (DOBERSTEIN ANDREW J [US] ET AL) 24 April 2008 (2008-04-24) * paragraphs [0049] - [0050]; figures 3-4, 6 *	1,2,6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F25C
Place of search		Date of completion of the search	Examiner
The Hague		24 August 2016	Melo Sousa, Filipe
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 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 42 5020

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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