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(72) Inventor: **KOBAYASHI, Luis Michio**
177 44 Järfälla (SE)

(74) Representative: **Electrolux Group Patents**
AB Electrolux
Group Patents
S:t Göransgatan 143
105 45 Stockholm (SE)

(71) Applicant: **Electrolux Appliances Aktiebolag**
105 45 Stockholm (SE)

(54) **HOUSEHOLD REFRIGERATOR AND OPERATING METHOD THEREOF**

(57) Refrigerator (1) comprising: a cabinet (2), which has a thermal-insulating structure and is internally provided with at least one, thermal-insulated storage cavity (3, 4) designed to accommodate perishable foodstuff, a user interface (20) which is configured to allow the user to set at least a control parameter and/or an operating program to be implemented by the refrigerator (1), an electrically-operated cooling system (7) which is configured to cool down the inside of the storage cavity (3, 4), an electronic control system (21) which is configured to: receive from said user interface control parameter and/or

program set by the user and control the operation of said electrically-operated cooling system (7) based on user setting. The electronic control system (21) is further configured to: estimate a resource consumption at least of the electrically-operated cooling system (7), when it operates based on user setting, determine a degree of ecological impact caused by the electrically-operated cooling system (7) based on the estimated resource consumption, communicate the determined degree of ecological impact to the user by means of the user interface (20).

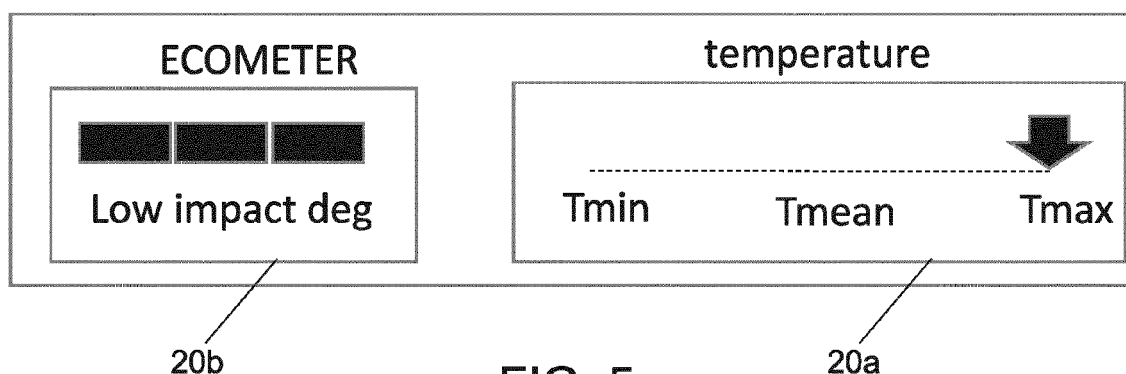


FIG. 5

Description

[0001] The present invention relates to a household refrigerator and an operating method thereof.

BACKGROUND ART

[0002] As is known, modern-generation household refrigerators are provided with graphical interfaces configured to allow the user to select a series of operating parameters used to control the operation of the refrigerator. For example, the user can vary the temperature in the cooling chamber and/or in the freezing chamber, and/or activate cooling or rapid freezing or defrost programs, or similar functions.

[0003] It is also known that the aforementioned user setting may causes a significant ecological environmental impact associated, for example, with the electrical consumption of the refrigerator, when operating based on such conditions/setting.

[0004] Nowadays the users are aware of the refrigerator control parameters but they do not know the extent of the ecological impact caused by the commands they gives to the refrigerator.

[0005] The aim of the present invention is therefore to provide a refrigerator, which is configured to inform users about the ecological impact caused in response to their setting.

DISCLOSURE OF INVENTION

[0006] In compliance with the above aims, according to the present invention there is provided a refrigerator comprising: a cabinet, which has a thermal-insulating structure and is internally provided with at least one, thermal-insulated storage cavity designed to accommodate perishable foodstuff; a user interface which is configured to allow the user to set at least a control parameter and/or an operating program to be implemented by said refrigerator, an electrically-operated cooling system which is configured to cool down the inside of said at least one storage cavity, an electronic control system which is configured to receive from said user interface said control parameter and/or said program set by the user and control the operation of said electrically-operated cooling system based on said user setting, comprising at least said control parameter and/or operating program, the electronic control system is further configured to: estimate a resource consumption at least of said electrically-operated cooling system, when it operates based on said user setting, determine a degree of ecological impact caused by said electrically-operated cooling system based on said estimated resource consumption, communicate said determined degree of ecological impact to the user by means of said user interface.

[0007] According to the present invention, the degree of ecological impact of the refrigerator is indicative of the energy consumption, e.g. electric power absorbed by at

least the electrically-operated cooling system during its operating. For example, it is possible to define a plurality of levels or degrees of ecological impact associated with respective level of consumption of electrical power of the electrically-operated cooling system. That is, the higher electrical power absorbed/consumed by the electrically-operated cooling system, the greater degree of ecological impact. In other words, the degree of ecological impact is proportional to the electrical power absorbed/consumed by the electrically-operated cooling system.

[0008] Preferably, the user interface is configured to allow the user to change the temperature in said storage cavity from a first temperature to at least a second temperature, the electronic control system is configured to: estimate a resource consumption of said electrically-operated cooling system caused by the changing of temperature from said first temperature to said second temperature, determine the degree of ecological impact caused by said electrically-operated cooling system based on said estimated resource consumption associated with said temperature changing, communicate said determined degree of ecological impact to the user by means of said user interface.

[0009] Preferably, the user interface is configured to allow the user to change the operating program from a first program to at least a second program, said electronic control system is configured to: estimate a resource consumption of said electrically-operated cooling system caused by said second operating program, determine the degree of ecological impact caused by said electrically-operated cooling system based on said estimated resources consumption associated to said second program, communicate said determined degree of ecological impact to the user by means of said user interface. It is understood that each program/functions, when it is implemented by the refrigerator, causes the electrically-operated cooling system to consume a respective prefixed electric power.

[0010] Preferably, the electrically-operated cooling system comprises an electrically-operated compressor, the electronic control system is configured to estimate said resource consumption based on the electrical consumption of said electrically-operated compressor when the refrigerator operates according to said user setting, determine the degree of ecological impact based on said resources consumption associated to said electrically-operated compressor.

[0011] Preferably, the electronic control system is configured to estimate the electrical consumption of electrically-operated compressor based on the operating speed and/or the operating time of said electrically-operated compressor caused by the user setting.

[0012] Preferably, the electrically-operated cooling system comprises an electrically-operated air-blowing device, the electronic control system is configured to estimate resource consumption based on the electrical consumption of said electrically-operated air-blowing device, when the refrigerator operates according to said user set-

ting, determine the degree of ecological impact based on said resources consumption associated to said electrically-operated air-blowing device.

[0013] Preferably the refrigerator comprises a defrost device provided with one or more electric heaters, the electronic control system is configured to estimate said resource consumption based on the electrical consumption of said electric heaters of said defrost device, when the refrigerator operates according to said user setting, determine the degree of ecological impact based on said resources consumption associated to said one or more electric heaters of the defrost device.

[0014] Preferably, the user interface comprises a display; said said electronic control system is configured to display by said user interface graphic icon-segments which changes based on said determined degree of ecological impact.

[0015] The technical effect is that the refrigerator informs .i.e. warns, in real time, the user about the ecological impact caused by his settings.

[0016] The present invention further concerns to a method of operating of a refrigerator comprising a user interface, an electrically-operated cooling system and electronic control system, said method comprising allowing a user to operate said user interface to set at least a control parameter and/or select an operating program to be implemented by said refrigerator, cooling down the inside of at least a storage cavity of said refrigerator by an electrically-operated cooling system, controlling by said electronic control system the operation of said electrically-operated cooling system based on the control parameter and/or the operating program set by user; the method comprises: estimating by said electronic control system a resource consumption of at least said electrically-operated cooling system when it operates based on the user setting, determining by said electronic control system a degree of ecological impact caused by said electrically-operated cooling system based on said estimated resource consumption, communicating said determined degree of ecological impact to the user by means of said user interface.

[0017] Preferably, the method comprises: allowing a user to operate said user interface to change the temperature in said storage cavity from a first temperature to at least a second temperature, estimating by said electronic control system a resource consumption of said electrically-operated cooling system caused by the changing of temperature from said first temperature to said second temperature, determining by said electronic control system the degree of ecological impact caused by said electrically-operated cooling system based on said estimated resource consumption associated with said temperature changing, communicating by means of said user interface said determined degree of ecological impact to the user.

[0018] Preferably, the method comprises allowing the operator to operate said user interface in order to change the operating program from a first program to at least a

second program, estimating by said electronic control system a resource consumption of said electrically-operated cooling system caused by said second operating program, determining by said electronic control system the degree of ecological impact caused by said electrically-operated cooling system based on said estimated resources consumption associated to said second program, communicating by means of said user interface said determined degree of ecological impact to the user.

[0019] Preferably, said electrically-operated cooling system comprises an electrically-operated compressor, the said method comprising: estimating by said electronic control system said resource consumption based on the electrical consumption of said electrically-operated compressor when the refrigerator operates according to said user setting, determining by said electronic control system the degree of ecological impact based on said resources consumption associated to said electrically-operated compressor.

[0020] Preferably, the method comprises: estimating by said electronic control system the electrical consumption of electrically-operated compressor based on the operating speed and/or the operating time of said electrically-operated compressor caused by the user setting.

[0021] Preferably, the electrically-operated cooling system comprises an electrically-operated air-blowing device, said method comprising: estimating by said by said electronic control system said resource consumption based on the electrical consumption of said electrically-operated air-blowing device, when it operates according to said user setting, determining by said electronic control system the degree of ecological impact based on said resources consumption associated to said electrically-operated air-blowing device.

[0022] Preferably, the refrigerator comprises a defrost device provided with one or more electric heaters, the method comprising: estimating by said by said electronic control system, said resource consumption based on the electrical consumption of said electric heaters of said defrost device, when the refrigerator operates according to said user setting, and determine by said by said electronic control system, the degree of ecological impact based on said resources consumption associated to said electric heaters defrost device.

[0023] Preferably said user interface comprises a display; said method comprising displaying by said user interface graphic icon-segments, which changes based on said determined degree of ecological impact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Further characteristics and advantages of the present invention will be highlighted in greater detail in the following detailed description of some of its preferred embodiments, provided with reference to the enclosed drawings.

[0025] A non-limiting embodiment of the present invention will now be described, by way of example, with ref-

erence to the accompanying drawings, in which:

- Figure 1 illustrates a schematic perspective view of a household refrigerator realized in accordance with the teachings of the present invention, with parts removed for clarity's sake,
- Figure 2 shows a schematic view of the electronic control system of the refrigerator realized in accordance with the teachings of the present invention,
- Figures from 3 to 8 illustrate respective examples of user interfaces of the refrigerator realized according to the present invention,
- Figure 9 is a flow chart of the operating method provided according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0026] With reference to Figures 1 and 2, reference number 1 denotes as a whole a refrigerator configured to preserve perishable foodstuff and preferably suitable for domestic use, i.e. a household refrigerator.

[0027] According to the embodiment illustrated in Figure 1, the refrigerator 1 comprises a preferably substantially parallelepiped-shaped cabinet 2. The cabinet 2 may be a self-supporting cabinet having a thermal-insulating structure. In the example shown, in particular, the cabinet 2 is preferably structured for stably resting on the floor/ground. The cabinet 2 is internally provided with at least one, preferably substantially parallelepiped-shaped, thermal-insulated storage cavity. The thermal-insulated storage cavity is designed to accommodate perishable food-stuff. The storage cavity communicates with the outside via a large, preferably roughly rectangular-shaped, access opening which is located on a main face/wall of the same cabinet 2.

[0028] According to the embodiment illustrated in Figure 1, the refrigerator 1 further comprises at least one sealing door that has a thermal-insulating structure and is flag hinged to the cabinet 2, so as to be manually rotatable to and from a closing position in which the door abuts on said main face/wall of the cabinet 2 to substantially airtight close the access opening of said storage cavity.

[0029] Refrigerator 1 further comprises an electrically-operated cooling system, which is at least partially accommodated inside the cabinet 2, and is structured/adapted to cool down the inside of said inner storage cavity.

[0030] Moreover, according to an exemplary embodiment illustrated in Figure 1, the cabinet 2 is preferably internally provided with two, substantially vertically-aligned, separate and adjacent storage cavities 3 and 4. The storage cavities 3 and 4 are thermal-insulated to one another and to the outside, are both adapted to accommodate perishable foodstuff, and finally communicate with the outside each via a respective large access opening preferably located on the main face/wall of the cabinet 2.

[0031] According to the exemplary embodiment illustrated in Figure 1, the refrigerator 1 furthermore comprises, for each inner storage cavity 3, 4, a respective sealing door 5, 6, which is preferably substantially rectangular in shape, and is preferably flag hinged to the front of the self-supporting cabinet 2 so as to be manually rotatable about a preferably substantially vertically-oriented, reference axis, to and from a closing position in which the door 5, 6 rests/abuts on the front face/ wall of cabinet 2 so as to cover and substantially airtight seal the access opening of the corresponding storage cavity 3 or 4. In the example shown in Figure 1, the storage cavity 3 is arranged above the storage cavity 4.

[0032] With reference to Figure 1, preferably the refrigerator 1 may additionally comprise, inside the storage cavity 3: at least one and preferably a number of nearly horizontally-extending and preferably manually removable, partitioning shelves 8 that are adapted to support perishable foodstuff, and are arranged inside the storage cavity 3 vertically spaced to one another; and optionally also one or more drawer containers 9, which are fitted in manually extractable manner into the storage cavity 3, preferably beneath the partitioning shelf or shelves 8, and are each adapted to accommodate vegetables and similar perishable foodstuff.

[0033] Preferably, the refrigerator 1 moreover may comprise at least one and preferably a number of second drawer containers 10 that are fitted in manually extractable manner into the storage cavity 4, preferably vertically-stacked to one another, and are each adapted to accommodate frozen perishable foodstuff. The storage cavity 4 may be a freezing compartment. The storage cavity 3 may be a refrigerating compartment.

[0034] With reference to Figure 2, the refrigerator 1 furthermore comprises electrically-operated cooling system 7, which is preferably structured/adapted to separately cool down the inside of storage cavity 3 and preferably additionally or alternatively the inside of storage cavity 4 of the cabinet 2.

[0035] The electrically-operated cooling system 7 is preferably designed to cool down the inside of storage cavity 3 so as to keep the inside of storage cavity 3 at a first target temperature and additionally, or alternatively, to cool down the inside of storage cavity 4 so as to keep the inside of storage cavity 4 at a second target temperature, which is preferably lower than the first target temperature. The first target temperature is preferably suitable for short-term preservation of perishable foodstuff inside of the storage cavity 3. The second target temperature is suitable for long-term preservation of perishable foodstuff. For example, the first target temperature is preferably greater than or equal to +0°C, whereas the second target temperature is lower than +0°C. Preferably, the first target temperature ranges between +2°C and +8°C, whereas the second target temperature ranges between -30°C and -10°C.

[0036] With reference to the exemplary embodiment illustrated in Figure 2, the electrically-operated cooling

system 7 comprises a heat-pump assembly 12. The heat-pump assembly 12 may comprise at least one low-pressure heat exchanger 12a, traditionally called evaporator, adapted to cool down the inside of the at least one, thermal-insulated storage cavity 3, 4 of the cabinet 2. Preferably, the heat-pump assembly 12 may be provided with a low-pressure heat exchanger 12b or evaporator for each storage cavity 3, 4 of the self-supporting cabinet 2.

[0037] The heat-pump assembly 12 may also comprise in addition to evaporators, an electrically-operated compressor 15. The electrically-operated compressor 15 is preferably housed into a specific compressor compartment (not shown) formed on the back of the cabinet 2, and is adapted to compress a low-temperature and low-pressure gaseous-state refrigerant arriving from any one of evaporators for supplying, at outlet/delivery, a flow of high-temperature and high-pressure refrigerant.

[0038] With reference to the exemplar embodiment shown in Figure 2, the electrically-operated cooling system 7 may further be designed to circulate the cold air in closed loop inside the storage cavity 3, and additionally or alternatively also to circulate the cold air in closed loop inside the storage cavity 4. Preferably, the electrically-operated cooling system 7 may also comprise at least an electrically-operated air-blowing device 16. The electrically-operated air-blowing device 16 may be designed to force the cold air to flow/circulate inside the storage cavity 3. The air-blowing device 16 may be an electrically-operated centrifugal fan.

[0039] With reference to Figure 2, the refrigerator 1 may further comprise at least a defrost device 30. The defrost device 30 may comprise one or more electric heaters i.e. electric resistances which are configured to be electrically activated to generate heat to perform the defrost function in the cavity 3 and/or in cavity 4. According to an exemplary embodiment (not illustrated), the defrost device 30 may comprise balancing heaters. Preferably, the defrost device 30 may comprise two balancing heaters associated to the low-pressure heat exchanger 12a and respectively the low-pressure heat exchanger 12b which are hydraulically connected in series one to the other. The balancing heaters may be electrically controlled in order to regulate the temperature in a storage cavity, i.e. the first temperature in the storage cavity 3, when a high cooling power is provided to the other storage cavity 4, for example the storage cavity 4 by the low-pressure heat exchanger.

[0040] With reference to Figure 2, the refrigerator 1 further comprises a user interface 20, which is configured to allow the user to set at least a control parameter. According to an exemplary embodiment, the user interface 20 is configured to allow the user to set at least a control parameter corresponding to the temperature of at least a storage cavity. For example, the user interface 20 is configured to allow the user to selectively set the temperature of the storage cavity 3 and/or the storage cavity 4. In other words, the user interface 20 is configured to allow the user to regulate/vary the refrigerating temper-

ature in the storage cavity 3 and to regulate/vary the freezing temperature in the storage cavity 4.

[0041] The user interface 20 may be also configured to allow the user to select an operating program to be implemented by the refrigerator 1. It is understood that with the term operating program is meant any freezing/cooling function which may be performed by the refrigerator

[0042] In the following description it will be considered only to increase the understanding of the present invention, but without losing in generality, that the user interface 20 is configured to allow the user to select on or more of the following programs: a standard or default operating program, and/or a program for rapid cooling the cavity 3 hereinafter indicated with Extra-Cool, and/or a program to rapid freezing the cavity 4 hereinafter indicated with Extra-Freez, and/or a program or function for selectively cooling a number of drawer containers 9 hereinafter indicated with Multi-Chill, and/or a defrost function hereinafter indicated with Defrost and/or a defrost balancing function hereinafter indicated with Balancing Defrost.

[0043] The user interface 20 may be preferably arranged on a door 5 or 6. For example the user interface 20 may comprise a touch screen interface. It is understood that, in addition or alternately, the user interface 20 may also comprise a mechanical interfaces comprising e.g. press-buttons (not illustrated) and revolvable knobs (not illustrated) operated by the user to control operation of the refrigerator 1.

[0044] With reference to Figure 2, the refrigerator 1 further comprises an electronic control system 21, which is configured to control the operation of the refrigerator 1. The electronic control system 21 may comprise electronic/electric control circuits and is electrically connected to the user interface 20 and to the electrically-operated cooling system 9, i.e. the electrically-operated compressor 15 and the air-blowing device 16.

[0045] The electronic control system 21 is configured to receive from the user interface, the control parameter and/or the program selected by the user. The electronic control system 21 is further configured to control the operation of said electrically-operated cooling system 7 based on the received control parameter and/or the received operating program.

[0046] According to the present invention, the electronic control system 21 is further configured to estimate a resource consumption of the electrically-operated cooling system 7 when it operates based on the user setting. The electronic control system 21 is also configured to determine a level or degree of ecological impact caused by the electrically-operated cooling system 7 based on the determined resource consumption. According to the present invention, the degree of ecological impact of the refrigerator is indicative of the energy consumption, e.g. electric power absorbed by at least the electrically-operated cooling system 7 during its operating. For example, it is possible to define a plurality of levels or degrees of

ecological impact associated with respective level of consumption of electrical power of the electrically-operated cooling system 7. That is, the higher electrical power absorbed/consumed by the electrically-operated cooling system 7, the greater degree of ecological impact. In other words, the degree of ecological impact is proportional to the electrical power absorbed/consumed by the electrically-operated cooling system 7. Therefore when the consume of electrical power of the electrically-operated cooling system 7 is low, the degree of the of ecological impact is low. Vice-versa when the consume of electrical power of the electrically-operated cooling system 7 is high, the degree of the of ecological impact is high. It is understood that the invention may envisage a number of degrees of the ecological impact depending on the levels of consume of electrical power of the electrically-operated cooling system 7.

[0047] According to the present invention, the electronic control system 21 is further configured to communicate the determined degree of ecological impact to the user by means of the user interface 20. The technical effect is that the refrigerator 1 informs .i.e. warns, in real time, the user about the ecological impact caused by his settings.

[0048] Figures 3, 4 and 5 illustrates an exemplary embodiment of the refrigerator 1, wherein the user interface 20 is a touch sensitive screen configured to display a temperature setting device 20a, and an ecometer device 20b.

[0049] As illustrated in a exemplary embodiment schematically shown in Figures from 3 to 5, the temperature setting device 20a is configured to allow the user to regulate or vary the temperature in a storage cavity 3 and/or 4, whereas the ecometer device 20b displays the degree of ecological impact caused by the regulation of the temperature made by the user.

[0050] In the exemplary embodiment illustrated in Figures from 3 to 8, the ecometer device 20b displays a ecometer scale. The ecometer scale may comprise a bar formed by a number of segments/portions associated with respective ecological impact degrees. For example, a full bar, e.g. all segments displayed (Figure 5) may be indicative of the lower impact degree; vice-versa a short bar, e.g. a single segment displayed (Figure 4) may be indicative of the higher degree of ecological impact.

[0051] In the example of Figure 3, the user sets the temperature at a mean value T_{mean} , i.e. corresponding to the temperature generated when the refrigerator operates in a normal or default condition/program. In this case, the electrically-operated cooling system 7 operates by absorbing a mean value of electrical power; the electronic control system 21 determines a degree of ecological impact corresponding to a mean impact degree and the ecometer device 20b regulates the bar to display a value (by the segments) which is indicative of the determined mean impact degree (two segments).

[0052] When the user commands a reduction of temperature from the mean value T_{mean} (Figure 3) to a min-

imum temperature T_{min} (Figure 4), the electronic control system 21 estimate an increasing of the consumption of electric power by the electrically-operated cooling system 7. In this case, the electronic control system 21 determines a degree of ecological impact corresponding to a high degree and the ecometer device 20b regulates the bar to display a value (by the segments) which is indicative of the determined high impact degree (Figure 4) (one segment).

[0053] When the user commands an increase of temperature to a maximum temperature T_{max} , the electronic control system 21 decreases the consumption of electric power. In this case, the electronic control system 21 determines a degree of ecological impact corresponding to a low degree, and the ecometer device 20b controls the bar to display a value (by the segments) which is indicative of the determined low impact degree (Figure 5) (three segments).

[0054] Figures 6, 7 and 8 illustrates an exemplary embodiment of the refrigerator 1, wherein the user interface 20 is a touch sensitive screen configured to display a program selecting device 20c and the ecometer device 20b.

[0055] The program selecting device 20c may be configured to allow the user to select a program and or a function among a number of prefixed programs/functions. It is understood that each program/functions, when it is implemented by the refrigerator 1, causes the electrically-operated cooling system 7 to consume a respective prefixed electric power.

[0056] Figure 6 shows an example wherein the user select the program A among three programs A, B and C. In the example of Figures 6-8, the program A may correspond to a normal or default condition/program. In this case, the electrically-operated cooling system 7 may operate by absorbing a mean value of electrical power. In this condition, the electronic control system 21 may determine a degree of ecological impact corresponding to a mean impact degree and the ecometer device 20b regulate the bar to display a value (by the segments) which is indicative of the determined mean impact degree (two segments).

[0057] When the user selects another program, e.g. program B (Figure 7), which causes an increase of the electric power consumed by electrically-operated cooling system 7, the electronic control system 21 determines a degree of ecological impact corresponding to a high degree and the ecometer device 20b regulates the bar to display a value (by the segments), which is indicative of the determined high impact degree (Figure 7) (one segment). The program B may correspond, for example, to: a Extra-Cool program, a Extra-Freeze program, a Multi-Chill program, a Defrost program/function, a Balancing Defrost function.

[0058] In Figure 8, the user selects another program, e.g. Program C, which causes a reduction of the electric power consumed by the electrically-operated cooling system 7.

[0059] In this condition, the electronic control system 21 determines a degree of ecological impact corresponding to a low degree, and the ecometer device 20b regulates the bar to display a value (by the segments), which is indicative of the determined low impact degree (Figure 8) (three segments). The program C may correspond, for example, to a Eco program configured to cause the electrically-operated cooling system 7 to absorb the lowest electric power.

[0060] It is understood that the electronic control system 21 may be configured to estimate the resource consumption based on the electrical consumption of the heat-pump system 1. For example, the electronic control system 21 may be configured to estimate the resource consumption based on: the operating speed and/or the operating time of the electrically-operated compressor which in turn depend on the temperature setting and/or the selected program.

[0061] The electronic control system 21 may also be configured to estimate the resource consumption based on the electrical consumption of the electrically-operated air-blowing device 16. For example the electronic control system 21 may be configured to estimate the resource consumption based on: the operating speed and/or the operating time of the electrically-operated air-blowing device 16, which in turn depend on the temperature setting and/or the selected program.

[0062] Furthermore, the electronic control system 21 may be configured to estimate the resource consumption based on the electrical consumption of the defrost device 30. For example the electronic control system 21 may measure the current/voltage and or the duty cycle of the electric signals supplied to electric resistors of defrost device 30 during the implementation of the Defrost function.

[0063] Figure 10 illustrates a flow chart of the steps implemented by the method of operating of the refrigerator 1.

[0064] The method comprises: allowing the user to operate the user interface 20 to set at least a control parameter and/or select an operating program to be implemented by refrigerator (block 100). For example in this step, the user interface 2 may display the temperature setting device 20a and the program selecting device 20c as illustrated in Figures 3-8. Moreover the user may regulate the temperature by the temperature setting device 20a and/or change the program and/or select a function by the program selecting device 20c as illustrated in Figures 3-8.

[0065] The method comprises estimating by the electronic control system 21 the resource consumption of the electrically-operated cooling system 7 when it operates based on the user setting (block 110). It is understood that in this step the electronic control system 21 may be configured to estimate the electric consumption of the devices which are activated to reach the operating condition based on the user setting. In other words the electronic control system 21 estimates the electric consumption

based on the functioning of the electrically operated compressor 15 and /or the air blowing device 16 and/or the defrost device 30 in response to the user setting.

[0066] The method comprises the step of determining by the electronic control system 21 the degree of ecological impact caused by said electrically-operated cooling system 7 based on the determined resource consumption (block 120). In this step the electronic control system 21 may be configured to determine the degree of ecological impact based on an impact function and/or data stored in an electronic memory of the electronic control system. Data may be stored in the memory according to consume tests made in laboratory in several operating condition of the refrigerator associated with the user setting.

[0067] The method comprises the step of communicating the determined degree of ecological impact to the user by means of the user interface (block 130).

[0068] The refrigerator and method described above are advantageous as allow the user to know in real time the ecological consequences that can be determined by his setting of the operation of the refrigerator.

[0069] Clearly, changes may be made to the refrigerator without, however, departing from the scope of the present invention.

Claims

1. Refrigerator (1) comprising:

a cabinet (2), which has a thermal-insulating structure and is internally provided with at least one, thermal-insulated storage cavity (3, 4) designed to accommodate perishable foodstuff, a user interface (20) which is configured to allow the user to set at least a control parameter and/or an operating program to be implemented by said refrigerator (1),

an electrically-operated cooling system (7) which is configured to cool down the inside of said at least one storage cavity (3, 4),

an electronic control system (21) which is configured to receive from said user interface said control parameter and/or said program set by the user and

control the operation of said electrically-operated cooling system (7) based on said user setting, comprising at least said control parameter and/or operating program, the refrigerator (1) being **characterized in that** said electronic control system (21) is further configured to:

estimate a resource consumption at least of said electrically-operated cooling system (7), when it operates based on said user setting,

determine a degree of ecological impact

- caused by said electrically-operated cooling system (7) based on said estimated resource consumption,
communicate said determined degree of ecological impact to the user by means of said user interface (20).
2. Refrigerator according to claim 1, wherein said user interface (20) is configured to allow the user to change the temperature in said storage cavity (3)(4) from a first temperature to at least a second temperature, said electronic control system (21) is configured to:
- estimate a resource consumption of said electrically-operated cooling system (7) caused by the changing of temperature from said first temperature to said second temperature,
determine the degree of ecological impact caused by said electrically-operated cooling system (7) based on said estimated resource consumption associated with said temperature changing,
communicate said determined degree of ecological impact to the user by means of said user interface (20).
3. Refrigerator according to claims 1 or 2, wherein said user interface (20) is configured to allow the user to change the operating program from a first program to at least a second program, said electronic control system (21) is configured to:
- estimate a resource consumption of said electrically-operated cooling system (7) caused by said second operating program,
determine the degree of ecological impact caused by said electrically-operated cooling system (7) based on said estimated resources consumption associated to said second program,
communicate said determined degree of ecological impact to the user by means of said user interface (20).
4. Refrigerator according to any of the foregoing claims, wherein said electrically-operated cooling system (7) comprises an electrically-operated compressor (15), said electronic control system (21) is configured to
- estimate said resource consumption based on the electrical consumption of said electrically-operated compressor (15) when the refrigerator (1) operates according to said user setting,
determine the degree of ecological impact based on said resources consumption associated to said electrically-operated compressor (15).
5. Refrigerator according to claim 4, wherein said said electronic control system (21) is configured to estimate the electrical consumption of electrically-operated compressor (15) based on the operating speed and/or the operating time of said electrically-operated compressor (15) caused by the user setting.
6. Refrigerator according to any of the foregoing claims, wherein said electrically-operated cooling system (7) comprises an electrically-operated air-blowing device (16), said electronic control system (21) is configured to
- estimate said resource consumption based on the electrical consumption of said electrically-operated air-blowing device (16), when the refrigerator (1) operates according to said user setting,
determine the degree of ecological impact based on said resources consumption associated to said electrically-operated air-blowing device (22).
7. Refrigerator according to any of the foregoing claims, comprising a defrost device (30), provided with one or more electric heaters, said electronic control system (21) is configured to
- estimate said resource consumption based on the electrical consumption of said electric heaters of said defrost device (30), when the refrigerator (1) operates according to said user setting,
determine the degree of ecological impact based on said resources consumption associated to said one or more electric heaters of the defrost device (30).
8. Refrigerator according to any of the foregoing claims, wherein said user interface (20) comprises a display; said electronic control system (21) is configured to display by said user interface graphic (20) icon-segments which change based on said determined degree of ecological impact.
9. Method of operating of a refrigerator (1) comprising a user interface (20), an electrically-operated cooling system (7) and electronic control system (21),
- said method comprising:
- allowing a user to operate said user interface (20) to set at least a control parameter and/or select an operating program to be implemented by said refrigerator (1),
cooling down the inside of at least a storage cavity (3, 4) of said refrigerator (1) by an electrically-operated cooling system (7),

controlling by said electronic control system (21) the operation of said electrically-operated cooling system (7) based on the control parameter and/or the operating program set by user,

said method being **characterized by comprising:**

estimating by said electronic control system (21) a resource consumption of at least said electrically-operated cooling system (7) when it operates based on the user setting, determining by said electronic control system (20) a degree of ecological impact caused by said electrically-operated cooling system (7) based on said estimated resource consumption, communicating said determined degree of ecological impact to the user by means of said user interface (20).

10. Method according to claim 9, comprising:

allowing a user to operate said user interface (20) to change the temperature in said storage cavity (3)(4) from a first temperature to at least a second temperature, estimating by said electronic control system (21) a resource consumption of said electrically-operated cooling system (7) caused by the changing of temperature from said first temperature to said second temperature, determine by said electronic control system (21) the degree of ecological impact caused by said electrically-operated cooling system (7) based on said estimated resource consumption associated with said temperature changing, communicate by means of said user interface (20) said determined degree of ecological impact to the user.

11. Method according to claims 9 or 10, comprising

allowing the operator to operate said user interface (20) in order to change the operating program from a first program to at least a second program, estimating by said electronic control system (21) a resource consumption of said electrically-operated cooling system (7) caused by said second operating program, determine by said electronic control system (21) the degree of ecological impact caused by said electrically-operated cooling system (7) based on said estimated resources consumption associated to said second program, communicate by means of said user interface

(20) said determined degree of ecological impact to the user.

12. Method according to any of the foregoing claims from 9 to 11, wherein said electrically-operated cooling system (7) comprises an electrically-operated compressor (15), said method comprising:

estimating by said electronic control system (21) said resource consumption based on the electrical consumption of said electrically-operated compressor (15) when the refrigerator (1) operates according to said user setting, determining by said electronic control system (21) the degree of ecological impact based on said resources consumption associated to said electrically-operated compressor (15).

13. Method according to claim 12, comprising: estimating by said electronic control system (21) the electrical consumption of electrically-operated compressor (15) based on the operating speed and/or the operating time of said electrically-operated compressor (15) caused by the user setting.

14. Method according to any of the foregoing claims from 9 to 13, wherein said electrically-operated cooling system (7) comprises an electrically-operated air-blowing device (16), said method comprising:

estimating by said by said electronic control system (21) said resource consumption based on the electrical consumption of said electrically-operated air-blowing device (16), when it operates according to said user setting, determining by said electronic control system (21) the degree of ecological impact based on said resources consumption associated to said electrically-operated air-blowing device (16).

15. Method according to any of the foregoing claims from 9 to 14, wherein said refrigerator comprise a defrost device (30), provided with one or more electric heaters, the method comprising:

estimating by said by said electronic control system (21), said resource consumption based on the electrical consumption of said electric heaters of said defrost device (30), when the refrigerator (1) operates according to said user setting, determine by said by said electronic control system (21), the degree of ecological impact based on said resources consumption associated to said electric heaters of said defrost device (30).

16. Method according to any of the foregoing claims from 9 to 15, wherein said user interface comprises a display; said method comprising: displaying by said user interface (20) graphic icon-segments, which changes based on said determined degree of ecological impact. 5
17. Computer program comprising instructions to cause the refrigerator (1) of claims from 1 to 8 to execute the steps of the method according to any one of the claims from 9 to 16. 10

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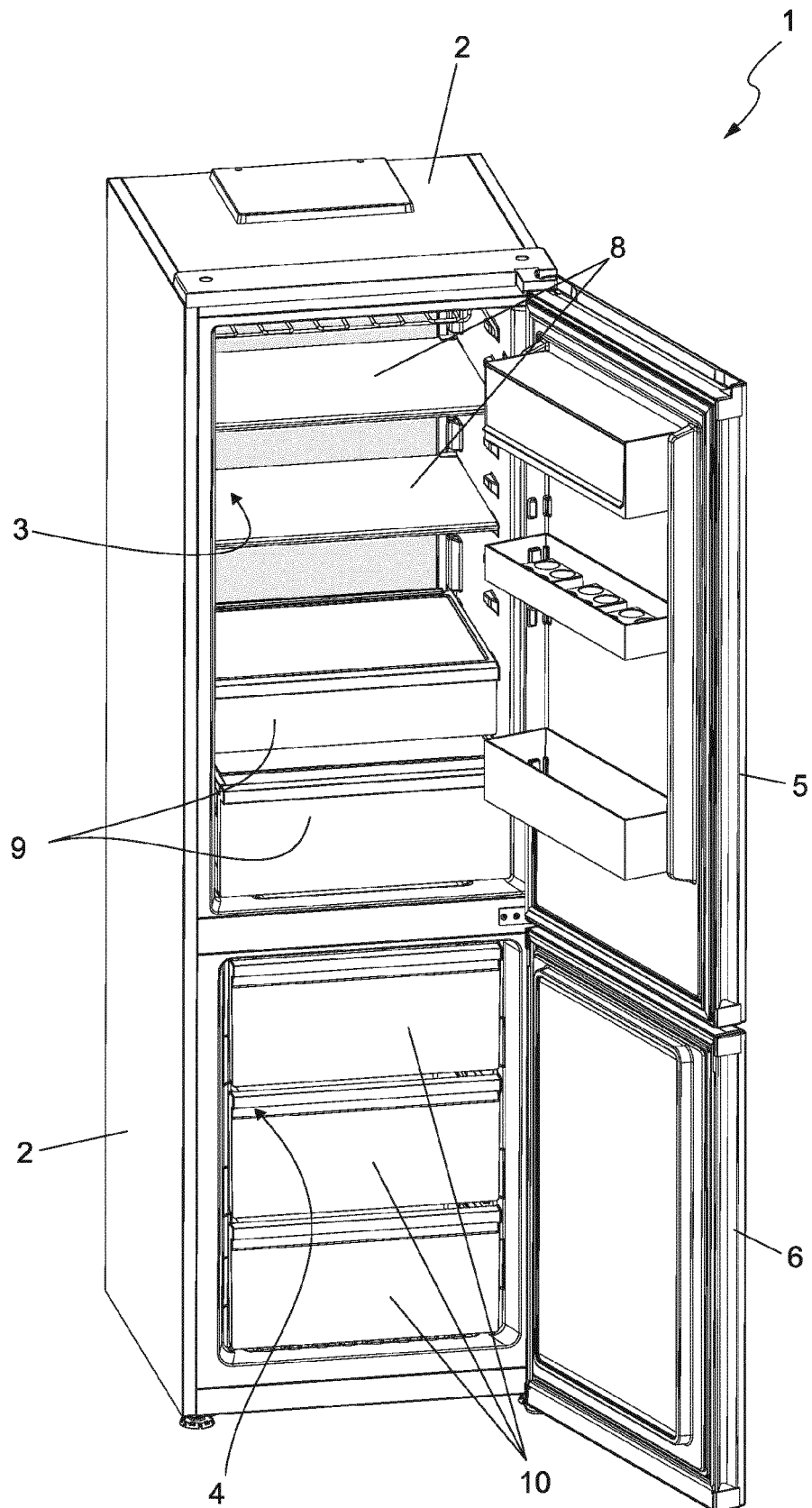


FIG. 1

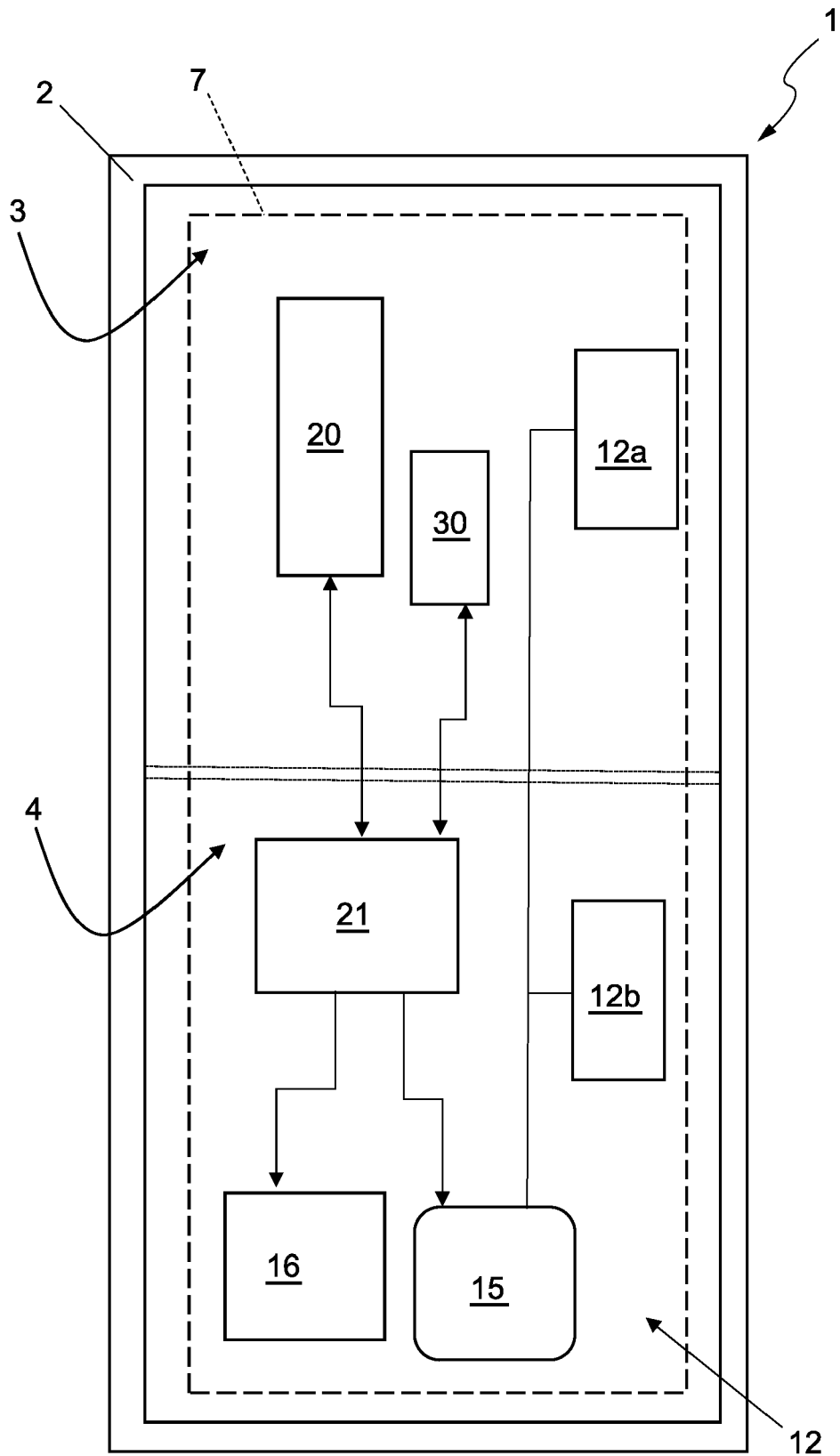
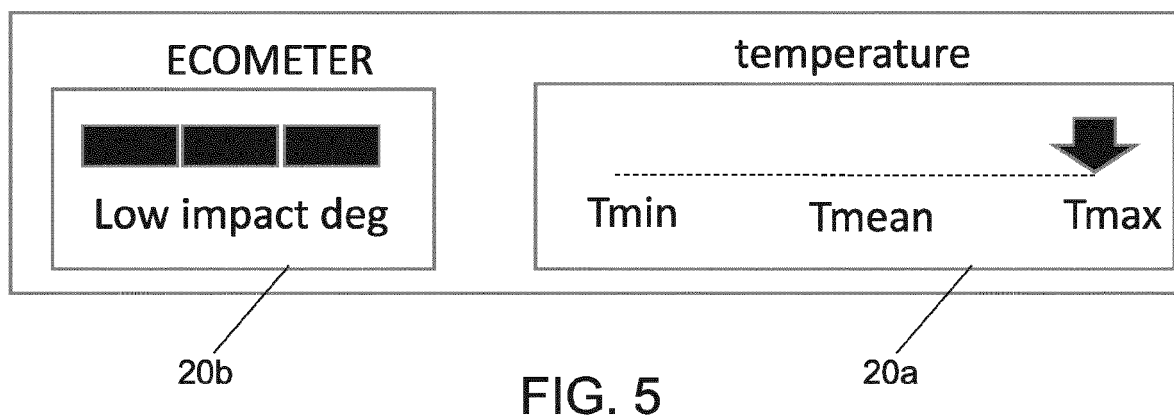
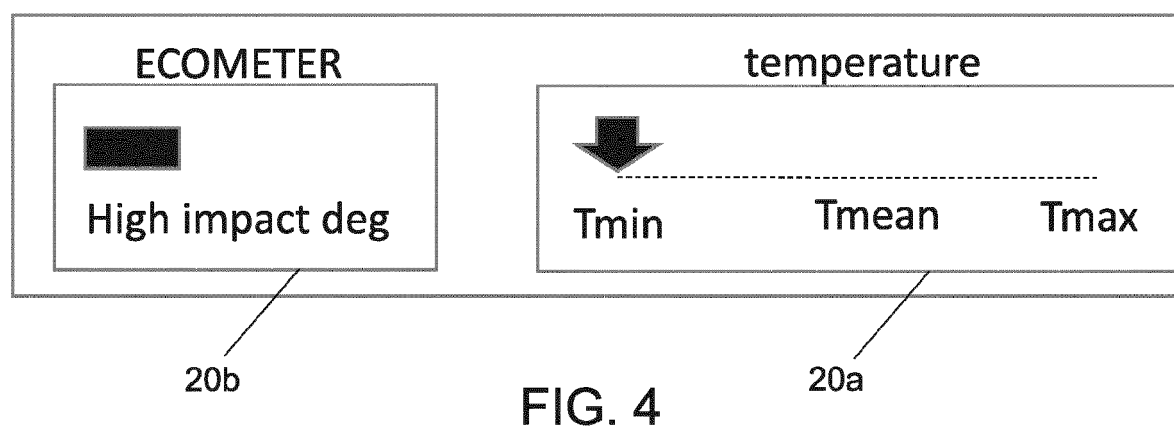
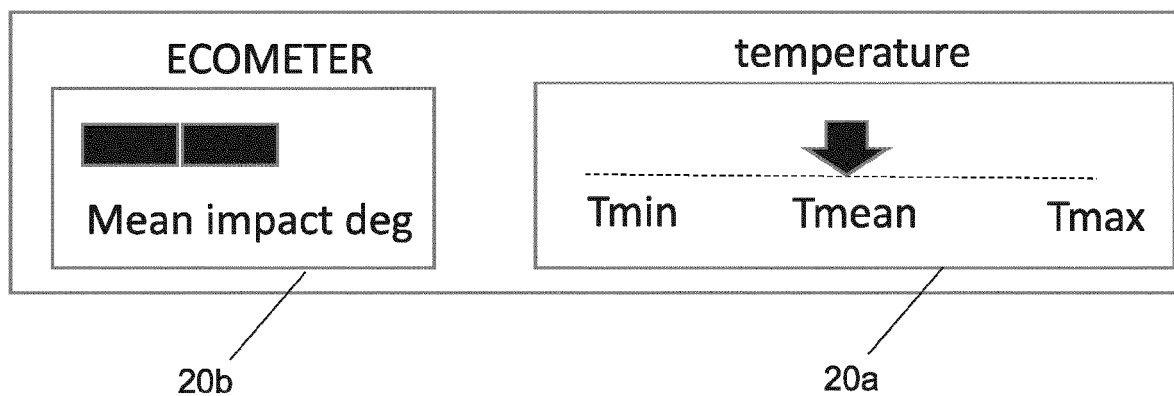
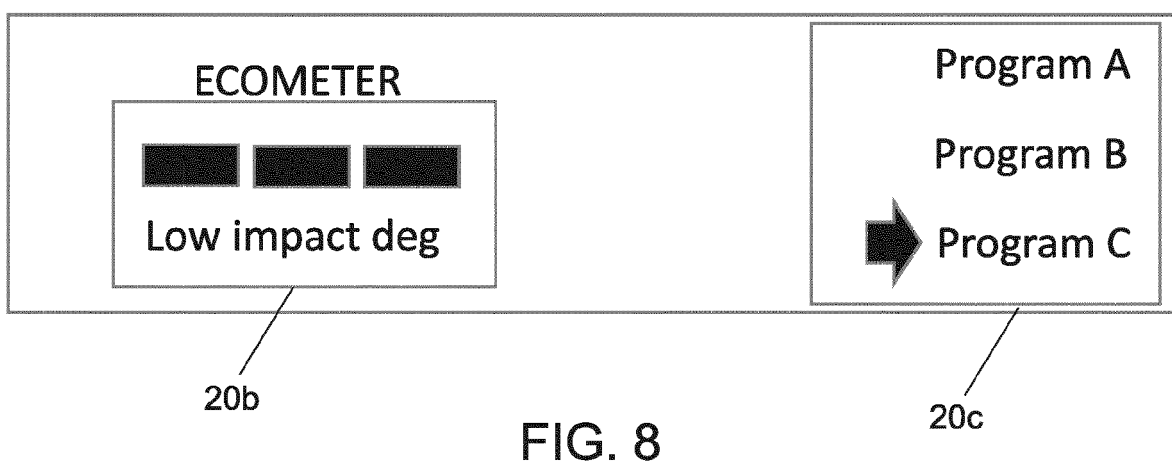
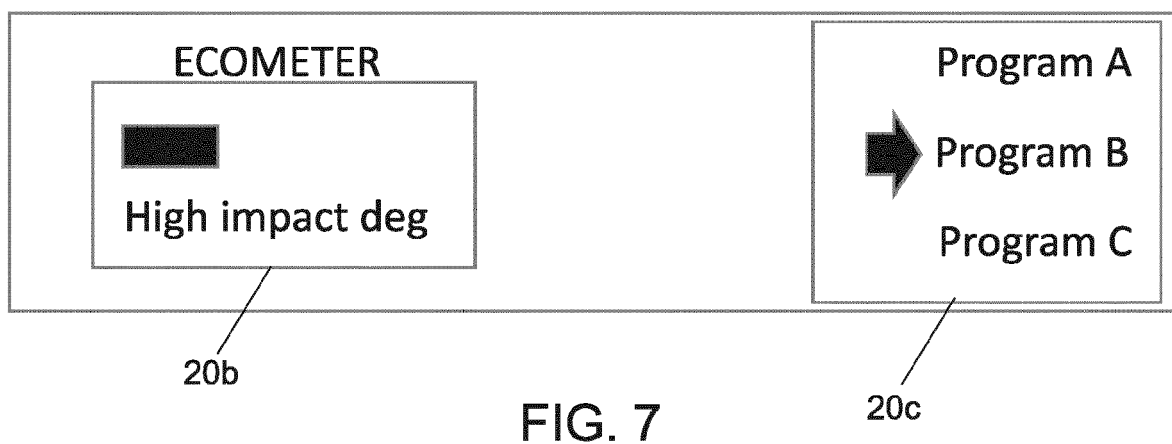
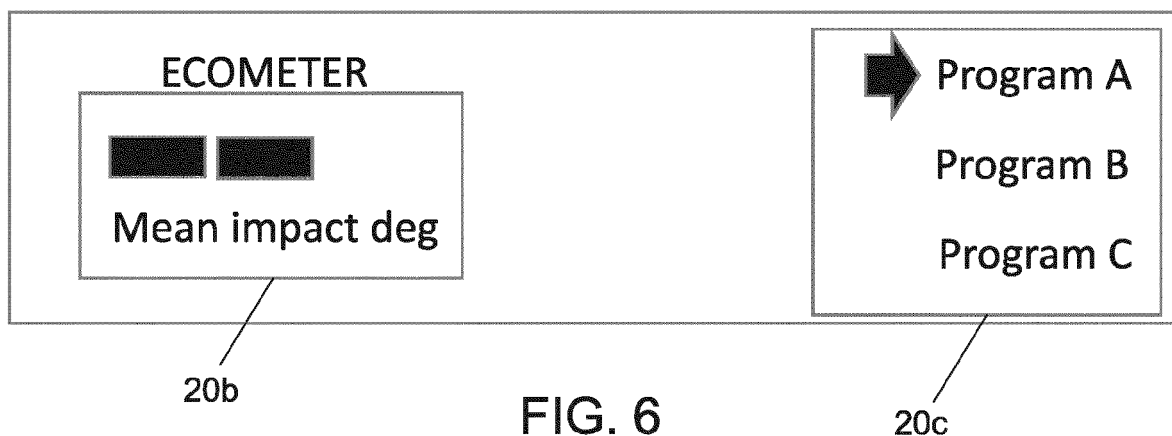


FIG. 2





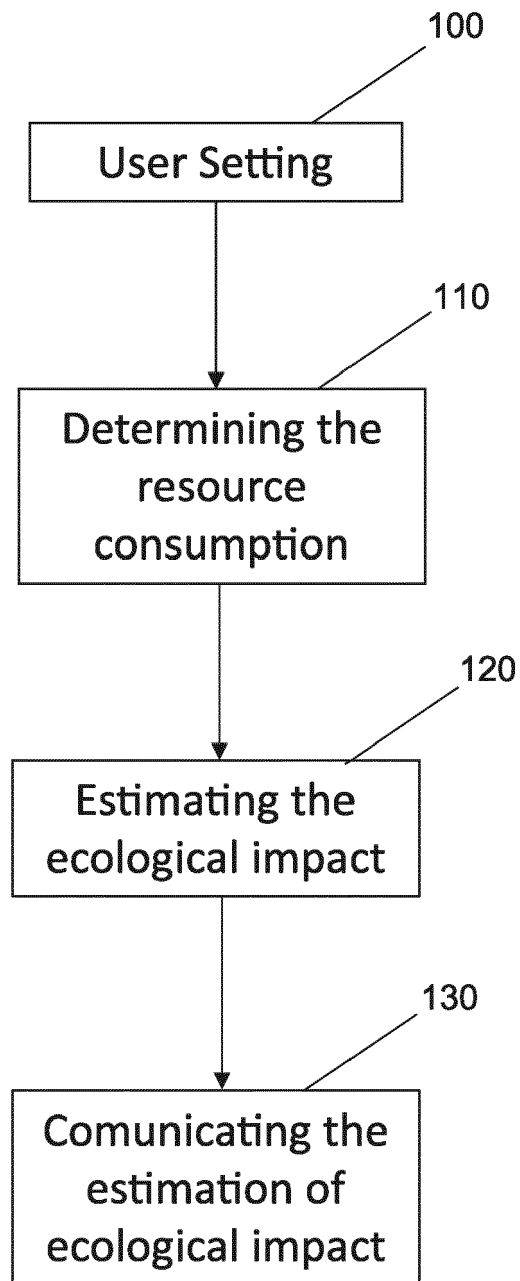


FIG. 9



EUROPEAN SEARCH REPORT

Application Number
EP 21 18 1177

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Place of search The Hague		Date of completion of the search 26 November 2021	Examiner Canköy, Necdet
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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26-11-2021

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