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(54) **A phase-change material that can be used both inside fridges and carrying bags**

(57) The invention is related to a cooling system comprising a household refrigerator (100) comprising an evaporator (1) that creates a cooling effect, a condenser (2) that releases out the heat during the cooling cycle, a compressor (3) that compresses the refrigerant to the condenser (2) pressure and -carrying bag (9), phase change material (8) which transfers the heat it has stored to the freezer (4) by being placed inside the lidded (4) section (7) formed on the freezer's (4) door of the refrigerator (100) and which cools the food products present in said insulated carrying bag (9), by being placed in the insulated carrying bag (9).

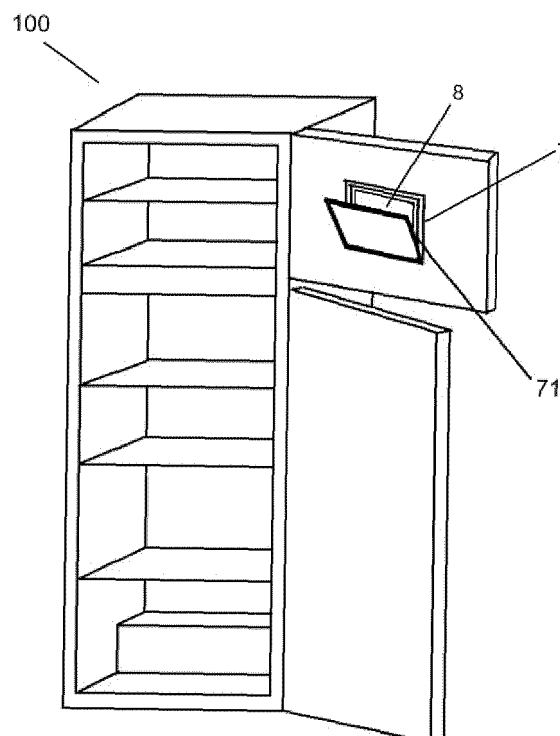


Figure 2

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## Description

### Technical Field

[0001] The invention relates to an evaporator with cooling effect, a condenser which releases the heat out during the refrigeration cycle and solving the problems about cooling and power save in the freezers of household refrigerators comprising a compressor which allows the compression of the refrigerant to the condenser pressure.

[0002] The invention especially relates to prolonging the duration of temperature rise by using a mobile phase-change material (PCM) inside a lidded division located in the freezers of said refrigerators, and saving power by reducing the working frequency of the compressor, in addition to this, the conservation of the heat of the food inside the carrying bag by locating the said phase-change material inside a specially insulated carrying bag.

### The State of the Art

[0003] Today, coolers (refrigerators and freezers) that enable foods to be preserved for a long time by keeping them cool are using vapour compression method as the cooling system. Simply in this method, evaporator, condenser, compressor and refrigerant (refrigerant gas) circulating inside this system are used. The evaporator vaporises the refrigerant with the heat it received from the cooling cabin. The refrigerant which goes through the condenser from there, condenses under high pressure with the help of the compressor and releases its heat. This way, the system which works at intervals creates a cooling effect by constantly releasing the heat out coming from the cooling cabin.

[0004] In the state of art, the efficiency of the coolers are directly related to the present heat insulation, internal and ambient temperature difference, the span of opening the door of the cooler (frequency of usage) etc. While efficient coolers, with compressor working for longer periods (longer period of heat rising) save power, the ones with low efficiency work more frequently (shorter period of heat rising) causing power loss. The efficiency of the cooling device is in direct proportion to preserving the low temperature created inside the cooling cabins. Preservation of the heat is one of the biggest problems today and there are different techniques and methods for trying to overcome it. In some of these methods, heat exchange between the cooling cabin and the external environment is lessened by using different insulating materials. However, considering there is no such thing as perfect insulation, these methods are not sufficient for improving the cooling performance.

[0005] Another problem faced in previous systems is, because of the power cuts caused by different reasons, the cooling system doesn't work and the food inside the cooling cabin which is exposed to heat is spoiled in a short notice. In the state of art, the cooling cabins don't

have the feature of storing low temperature.

[0006] 'Phase change material', corresponds to the term 'Phase Change Material' (PCM) in English. Phase-change materials are materials characterized in taking or giving high amounts of energy in phase transitions happening at a certain temperature such as solid to liquid or liquid to solid. The material at a temperature different from the phase change temperature, stores or releases out the heat in a conventional way. The heat which causes the material to change phase is called 'latent heat' or 'phase change heat'.

[0007] Phase change material that change phase in a certain heat can be used to store high or low temperature levels. Some other materials also have high latent heat like phase change materials, however the alteration in their physical structure during the phase change makes them difficult to use.

[0008] In the state of art, many organic and inorganic materials like salt hydrates, alcohol mixtures are used as phase change material. Because of their ability to store heat, they are frequently used in areas such as energy save in buildings, medical treatment etc.

[0009] As a result, for lengthening the temperature rise time of refrigerators, lessening the compressor's working frequency and overcoming the problems of preserving the low temperature in the cooler in the cases like power cuts that disrupt the working of the refrigerators and because of the insufficiency of the present solutions for it calls for a development in related technical field.

### The Object of the Invention

[0010] The invention influenced by the current art, aims to solve the above mentioned problems.

[0011] The present invention relates to meeting the above mentioned needs, eliminating all the disadvantages and bringing in additional advantages, lengthening the temperature rise time by placing mobile phase-change material inside the lidded sections located in the doors of household refrigerators, increasing the efficiency and lessening the consumption of energy.

[0012] The object of the invention is to store low temperature with the help of the phase-change material located inside the lidded section placed in the door of the freezer and by lengthening the temperature rise time lessening the working frequency of the compressor. Hence, the compressor saves power by working less and resting longer.

[0013] Another object of the invention is to preserve the low temperature inside the cabin in the cases like power cuts which disrupts the working of the refrigerator by locating phase-change material located inside the lidded section placed in the door of the freezer.

[0014] Another object of the invention is by placing the phase-change material located inside the lidded section placed in the door of the freezer with the help of an insulated carrying bag like a bag to carry the products that need low temperature. Thanks to the phase-change ma-

terial located in the lidded section in the freezer, space is saved.

[0015] To achieve the above mentioned goals, a cooling system which comprises,

- a household refrigerator comprising an evaporator creating cooling effect, a condenser that helps the releasing out of heat during the refrigeration cycle, a compressor which allows the compaction of the refrigerant with condenser pressure,
- carrying bag and,
- phase change material which transfers the heat it has stored to the freezer by being placed inside the lidded section formed on the freezer's door of the refrigerator, and which cools the food products present in said insulated carrying bag, by being placed in the insulated carrying bag

is developed.

[0016] The structural and the characteristic features and all advantages of the present invention will be understood more clearly with the following figures and the detailed description written by referring to said figures. Therefore, the evaluation needs to be done by taking these figures and the detailed description into consideration.

## BRIEF DESCRIPTION OF THE FIGURES

[0017] To fully understand the structure of the present invention and its advantages with additional elements, the evaluation needs to be done with the figures explained below.

**Figure 1:** The side view of the refrigerator comprising phase change material placed inside a section in the freezer.

**Figure 2:** The front view of the refrigerator comprising phase change material placed inside a section in the freezer.

**Figure 3:** The open and closed views of the carrying bag with phase change material placed inside it.

**Figure 4:** The front view of the lidded section with phase change material placed inside it.

[0018] The figures are not need to be scaled and the details which are not necessary to understand the present invention may have been neglected. Apart from that, the elements which are at least substantially identical and which at least have substantially identical functions are shown with the same numerals.

## Reference Numerals

### 100.Refrigerator

[0019]

1. Evaporator
2. Condenser
3. Compressor
4. Freezer
5. Cooler
6. Polyurethane insulation
7. Section

71. Lid

8. Phase change material
9. Carrying bag
10. Beverage case

## Detailed Description of the Invention

[0020] In this detailed description the preferred alternatives of the cooling system according to the invention, are explained with the intention of better explaining the subject and without causing any limiting effects.

[0021] The cooling system according to the invention consists of household refrigerator (100), insulated carrying bag (9) and phase change material (8).

[0022] The function of the elements located inside and on the household refrigerator (100) is: an evaporator (1) connected to the freezer (4) and cooler (5) in the refrigerator (100), absorbs the heat there and then it makes the refrigerant it comprises transfer into gas phase. Then the refrigerant moves to the condenser (2), gets compressed by high pressure providing compressor (3) and transforms into liquid phase again and releases its heat to outer environment. The liquid refrigerant goes back to the evaporator (1). Thanks to the heat cycle created in this way, the cooling effect is created inside the freezer (4) and the cooler (5). The -18°C inside the freezer(4) and the 5°C low heat inside the cooler (5) are insulated from the outer environment thanks to the polyurethane insulation (6). The cooling performance is directly related to the power of the compressor (3) and the efficiency of the insulation material.

[0023] In the structure according to the invention, phase change material (8) can store low level heat thanks to its structure. By repeatedly giving the low level heat it acquires from the evaporator (1) inside the freezer (4) to the freezer (4) during the stopped time of the compressor (3), it lengthens the temperature rise time, hence the stopped time. Thus, power save is achieved. Moreover, with the reduction of the frequency of compressor's (3) on/off period, the said compressor's (3) economic life increases. This situation also increases the economic life of the refrigerator (100).

[0024] Phase-change material (8) is placed inside the lidded (71) section (7) located on the door of the freezer (4). This way, it doesn't occupy space in the freezer (4) and the view is improved. Thanks to the lid (71) present in said section (7), the phase change material (8) can be disassembled. In addition, by placing the phase change material (8) inside the insulated carrying bag (9), it can

be carried anywhere without losing temperature. The carrying bag (9) used with phase change material (8), in the places without cooling means, cools the foods and beverages and this way makes them stay cool for a longer time and makes them easily carried from one place to another. Thanks to the lidded (71) section (7) inside the freezer (4), the consumer can easily put the phase change material (8) in its place, and make it ready for the next use.

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## Claims

### 1. A cooling system comprising;

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- a household refrigerator (100) comprising an evaporator (1) that creates a cooling effect, a condenser (2) that releases out the heat during the cooling cycle, a compressor (3) that compresses the refrigerant to the condenser (2) pressure and
- a carrying bag (9),

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and **characterized by comprising** phase change material (8) which:

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- transfers the heat it has stored to the freezer (4) by being placed inside the lidded (4) section (7) formed on the freezer's (4) door of the refrigerator (100), and,
- cools the food products present in said insulated carrying bag (9), by being placed in the insulated carrying bag (9).

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