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(54) **Refrigerator having refrigerating compartment with zones at different temperatures.**

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**CH-A- 584 874**
**DE-A-2 928 774**
**GB-A-2 079 424**
**US-A-2 707 871**

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## Description

The present invention relates to a refrigerator having a refrigerating compartment with zones at different temperatures. More particularly the present invention relates to a refrigerator having a cooling circuit that allows two or more zones at different temperatures to be obtained within the refrigerating compartment of a refrigerator, employing a static evaporator as a cooling system.

At the present time, refrigerators which are commercially available employing a static evaporator for cooling the refrigerating compartment have within said compartment a substantially uniform temperature distribution, except for a slight stratification of colder temperatures at the bottom.

Anyway, the maximum temperature difference occurring between the various zones is of about 2-3°C.

In order to obtain a refrigerating compartment having zones at different temperatures, some refrigerators are proposed at the present time on the market which make use of a ventilated evaporator also for said refrigerating compartment together with some different types of adjustable channel means that allow the refrigerating air flow to be conveyed into said compartment.

On the other side, said coupling gives rise to a number of economic drawbacks originating from the employment of a ventilated evaporator as well as from the presence of said channel means.

Moreover, ventilated evaporators are employed in freezing compartments as the dehydrating action of such evaporators on foodstuffs which are usually stored within the refrigerating compartment causes said foodstuffs to be badly conserved.

It is also well evident that, in order to warrant a good conservation of all foodstuffs stored within the refrigerating compartment, it is necessary to have within said compartment zones at different temperatures.

More particularly, the ideal temperature for a good conservation of eggs, butter, milk etc. is of about 5°, whereas in the case of vegetables and fruit the ideal temperature is of about 7° and for meat and fish it is of about 0°C.

From these date it can be observed that the temperature differences are quite high and that remarkable technical difficulties undoubtedly arise in the attempt at obtaining a temperature difference, $\Delta T$, of about 7—8°C within the same room and by means of the same cooling system.

In the patent DE-A-2 928 774 a refrigerating compartment with a cooling circuit is described, which circuit comprises a static evaporator, made up of a number of cooling elements that are fed in series by a compressor, conveyor wall means in said refrigerating compartment creating a way for the flow of the descending cold air, and port means arranged at a lower position with respect to the conveyor wall and creating a way for the flow of the cold descending air through the zone of the refrigerating compartment which is adjacent to the zone wherein the compressor is housed.

The aim of said circuit is that of obtaining a uniform temperature distribution.

It is quite evident from the above that it is very important to have at one's disposal a cooling system such as that proposed by the Applicant, said system allowing to obtain said zones at different temperatures within the refrigerating compartment through the employment of a static evaporator.

To obtain said object, the present invention proposes a refrigerator comprising a refrigerating compartment and a cooling circuit, said cooling circuit comprising a static evaporator which is made up of at least two cooling elements arranged at different heights in the refrigerating compartment, conveyor wall means, creating a way for the flow of the descending cold air, and port means, arranged at a lower position with respect to the conveyor wall means and creating a way for the flow of the cold descending air through a zone of the refrigerating compartment adjacent to a zone wherein the compressor is housed, characterized in that said cooling elements are fed in series by the compressor in the rising direction, and in that said conveyor wall means has a vertical portion spaced from and opposite to the lower cooling element and a horizontal portion forming the bottom of a cold zone of the refrigerating compartment and defining a channel between this bottom and the compressed housing zone of the refrigerating compartment, in which channel said port means are disposed.

According to the particularly preferred embodiment of the refrigerator of the invention, two cooling elements are provided, the first of said elements having a cooling power lower than that of the second of said elements, this last element being arranged within an upper zone of the refrigerating compartment.

Again according to the invention, the size of said two cooling elements and the structure of said conveyor wall means and said port means allows to obtain inside said refrigerating compartment three zones at different temperatures, the highest temperature being obtained in a bottom zone, the lowest temperature being obtained in a middle zone and the middle temperature being obtained in an upper zone.

More particularly, said three zones will be respectively at temperatures of about +7°C, about 0°C and about +5°C.

The present invention will be disclosed in the following for illustrative but not for limitative purposes with particular reference to the Figures of the enclosed drawings, wherein:

Figure 1 shows a schematic view of a longitudinal vertical cross section of a refrigerator

working on a cooling circuit according to the present invention;

Figure 2 shows an exploded perspective view of the refrigerator of Figure 1; and

Figure 3 shows a refrigerator working on a cooling circuit according to the Present invention with the indications pointing out the zones at different temperatures.

With reference now to Figures from 1 to 3, numbers 1 and 2 point out respectively the refrigerating compartment and the freezing compartment.

Th cooling circuit of the refrigerating compartment 1 only will be disclosed, because the realization of the cooling circuit of the compartment 2 is independent of the object of the present invention.

The static evaporator is made up of a number of series-connected elements. Just two elements are shown in the figure, which are pointed out by the reference numbers 3 and 4, but it is clearly evident that a number of said elements can be provided which can be varied according to the specific needings.

The compressor of the cooling circuit is housed as usually within the housing 5 arranged in the back lower zone of the refrigerating compartment.

Combining opportunely the elements of the cooling circuit with the tendency of cold air to become layered towards the bottom space, various temperature combinations can be obtained, one of said combinations which is of special interest being represented in the figures.

The element 4 of the evaporator shown in Figure 1 is of such a size as to obtain a temperature of about +5°C within in the zone 6 of the compartment 1; see also Figure 3.

The element 3 of said evaporator is in turn of such a size as to obtain an average temperature of about 0°C within the zone 7 of said compartment 1.

In order to obtain such temperature in the zone 7 without oversizing the element 3, a conveyor wall 8 is arranged parallel to the bottom wall 9 of the compartment 1, which wall forms a forced way for the flow of cold air descending from the zone 6 as shown by the arrows 10, 11 and, after said air has heated subtracting heat from the environment of said zone 7 according to arrow 12 (see Figure 2).

Arrows 13 and 14 point out respectively the direction of cold air created by said element 4 within the zone 6 and of the hotter air coming from the bottom space.

In order to obtain a right working of such cooling circuit also with very low working percentages of the compressor it is necessary that the two elements 3 and 4, and in general the elements provided as desired, are fed in the rising direction, i.e., the element 3 is to be fed first, whereas the element 4 is to be fed after it.

Thus, two zones are obtained within said compartment 1, the upper zone being at about +5°C whereas the lower zone is at about 0°C, i.e. at the optimal temperatures for storing foodstuffs such as milk, butter, cheese and the like, and meat.

In order to obtain in the lower part of said compartment 1 a zone at an average temperature of about 7°C, which zone is pointed out in the figures by the reference number 15, it will be sufficient to make the port 16 for the flow from the zone 7 of a suitable size so that a part of cold air conveyed by means of the conveyor wall 8 as well as a part of cold air created by the element 3 of the static evaporator both flow through said port 16 instead of following the path pointed out by arrow 11, said air flow going out of the lower part of said zone 15 following the direction of arrow 17 (see Figure 2).

Thus a zone has been obtained at an average temperature which is optimal for storing fruit and vegetables, with no need for any further element of the static evaporator, just at a point corresponding to the space in which such foodstuffs are stored usually.

**Claims**

1. A refrigerator comprising a refrigerating compartment (1) and a cooling circuit, said cooling circuit comprising a static evaporator which is made up of at least two cooling elements (3, 4) arranged at different heights in the refrigerating compartment (1), conveyor wall means (8), creating a way for the flow of the descending cold air, and port means (16), arranged at a lower position with respect to the conveyor wall means (8) and creating a way for the flow of the cold descending air through a zone (15) of the refrigerating compartment (1) adjacent to a zone (5) wherein the compressor is housed, characterized in that said cooling elements (3, 4) are fed in series by the compressor in the rising direction, and in that said conveyor wall means (8) has a vertical portion spaced from and opposite to the lower cooling element (3) and a horizontal portion forming the bottom of a cold zone (7) of the refrigerating compartment (1) and defining a channel between this bottom and the compressed housing zone (5) of the refrigerating compartment (1), in which channel said port means (16) are disposed.

2. A refrigerator according to claim 1 wherein two cooling elements (3, 4) are provided, the first (3) of said elements having a cooling power lower than that of the second (4) of said elements, this last element (4) being arranged within an upper zone (6) of the refrigerating compartment (1).

3. A refrigerator according to claim 1 or 2, wherein the size of said two cooling elements (3, 4), and the structure of said conveyor wall means (8) and said port means (16) allows to obtain inside said refrigerating compartment (1) three zones (6, 7, 15) at different temperatures, the highest temperature being obtained in a bottom zone (15), the lowest temperature being obtained in a middle zone (7) and the middle temperature being obtained in an upper zone (6).

4. A refrigerator according to claim 3, wherein said three zones (15, 7, 6) are respectively at

temperatures of about +7°C, about 0°C and +5°C.

**Patentansprüche**

1. Kuehlschrank mit einem Kuehlfach (1) und einem Kuehlkreislauf, der einen statischen Verdampfer, der aus mindestens zwei, auf verschiedenen Hoehen im Kuehlfach (1) angeordneten Kuehlelementen (3, 4) gebildet ist, sowie mit einer Leitwandanordnung (8), welche einen Weg fuer den Fluss absinkender luft bildet und eine Oeffnungsanordnung (16) enthaelt, die in einer gegenueber der Leitwandanordnung niedrigeren Lage angeordnet ist und einen Weg fuer den Fluss der absinkenden Luft durch eine Zone (15) des Kuehlfachs (1) bildet, die sich neben der Zone (5) befindet, in der der Kompressor untergebracht ist, dadurch gekennzeichnet, dass die genannten Kuehlelemente (3, 4) nacheinander in der ansteigender Richtung durch den Kompressor gespeist werden und dass die genannte Leitwandanordnung (8) einen senkrechten, vom niedrigeren Kuehlelement (3) entfernten und diesem gegenueberstehenden Teil und einen waagerechten, den Boden einer Kuehlzone (7) des Kuehlfaches (1) bildenden und einen Kanal zwischen diesem Boden und der den Kompressor aufnehmenden Zone (5) des Kuehlfaches (1) begrenzenden Teil aufweist, wobei in diesem Kanal die genannte Oeffnungsanordnung (16) vorgesehen ist.

2. Kuehlschrank nach dem Anspruch 1, dadurch gekennzeichnet, dass zwei Kuehlelemente (3, 4) vorgesehen sind, von denen das erste Element (3) eine niedrigere Kuehlleisttung hat als das zweite Element (4), wobei das zweite Element (4) in einer oberen Zone (6) des Kuehlfaches (1) angeordnet ist.

3. Kuehlschrank nach den Anspruechen 1 und 2, dadurch gekennzeichnet, dass die Groesse der genannten Kuehlelemeten (3, 4) und der Aufbau der genannten Leitwandanordnung (8) und der genannten Oeffnungsanordnung (16) innerhalb des Kuehlfaches (1) drei Zonen (6, 7, 15) mit verschiedenen Temperaturen zu erhalten gestattet, wobei die hoechste Temperatur in einer Bodenzone (15), die niedrigste Temperatur in einer mittleren Zone (7) und die mittlere Temperatur in der oberen Zone (6) erhalten wird.

4. Kuehlschrank nach dem Anspruch 3, dadurch gekennzeichnet, dass die genannten drei Zonen (15,7,6) Temperaturen von etwa +7°C, 0°C bzw. +5°C aufweisen.

**Revendications**

1. Réfrigérateur comprenant un compartiment de réfrigération (1) et un circuit de refroidissement, qui comprend un évaporatuer statique constitué, au moins, de deux éléments de refroidissement (3,4) disposés à des niveaux differents dans le compartiment de réfrigération (1), des moyens formant paroi d'acheminement (8) formant une voie d'écoulement de l'air froid descendant et des moyens formant orifices (16) disposés à un niveau inférieur par rapport aux moyens formant la paroi d'acheminement (8) qui ménageant une voie d'écoulement de l'air froid descendant à travers une zone (15) du compartiment de réfrigération (1) qui est adjacente à une zone (5) dans laquelle est logé le compresseur, caractérisé en ce que les éléments de refroidissement (3, 4) sont alimentés en série et dans le sens montant par le compresseur et que les moyens formant la paroi d'acheminement (8) ont une partie verticale distancée de l'élément de refroidissement inférieur (3) et opposée par rapport à cet élément (3) et une partie horizontale formant le fond d'une zone froide (7) du compartiment de réfrigération (1) et un canal entre ce fond et la zone comprimée de logement du compartiment de réfrigération (1) dans lequel lesdits moyens formant orifices (16) sont disposés.

2. Réfrigérateur selon la revendication 1, caractérisé, en ce que deux éléments de refroidissement (3, 4) sont prevues, le premier (3) de ces éléments ayant une puissance de refroidissement inférieure à celle du second élément (4), lequel est disposé dans une zone supérieure (6) du compartiment de réfrigération (1).

3. Réfrigérateur selon les revendications 1 ou 2, caractérisé en ce que la dimension des deux éléments de refroidissement (3, 4) et la structure des moyens formant la paroi d'acheminement (8) et des moyens formant orifices (16) sont telles que l'on obtient à l'interieur du compartiment de réfrigération (1) trois zones (6, 7, 15) ayant des températures différentes, la température la plus élevée étant obtenue dans la zone de fond (15), la température la plus basse étant obtenue dans une zone médiane (7) et la température intermédiaire est obtenue dans la zone supérieure (6).

4. Réfrigérateur selon la revendication (3), caractérisé en ce que les trois zones (15, 7, 6) sont respectivement à des temperatures d'environ +7°C, 0°C et +5°C.

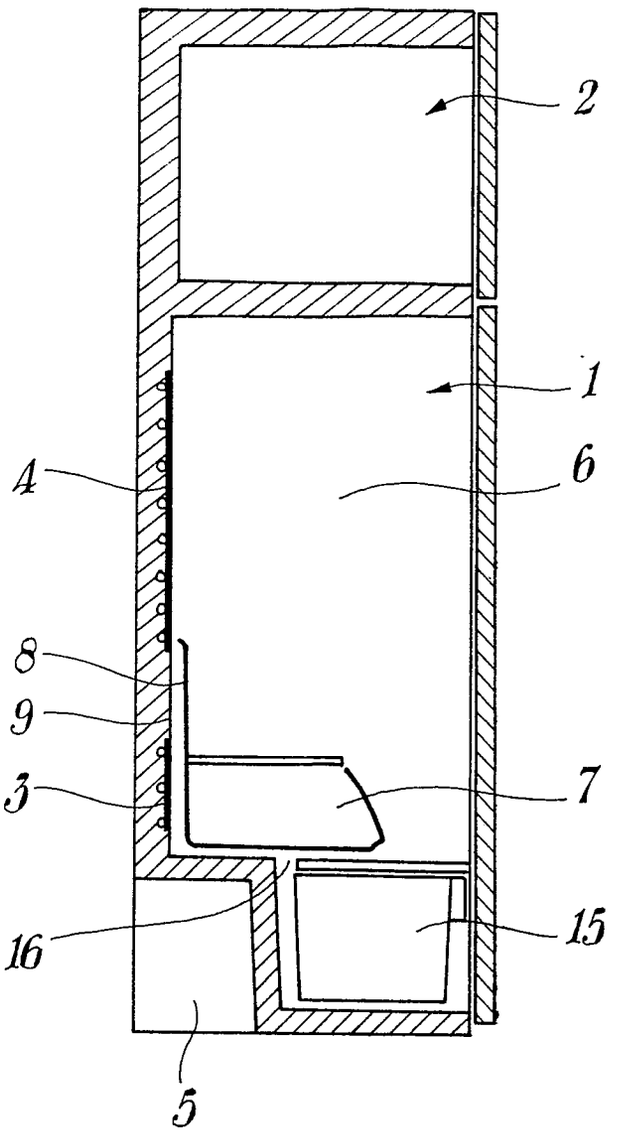
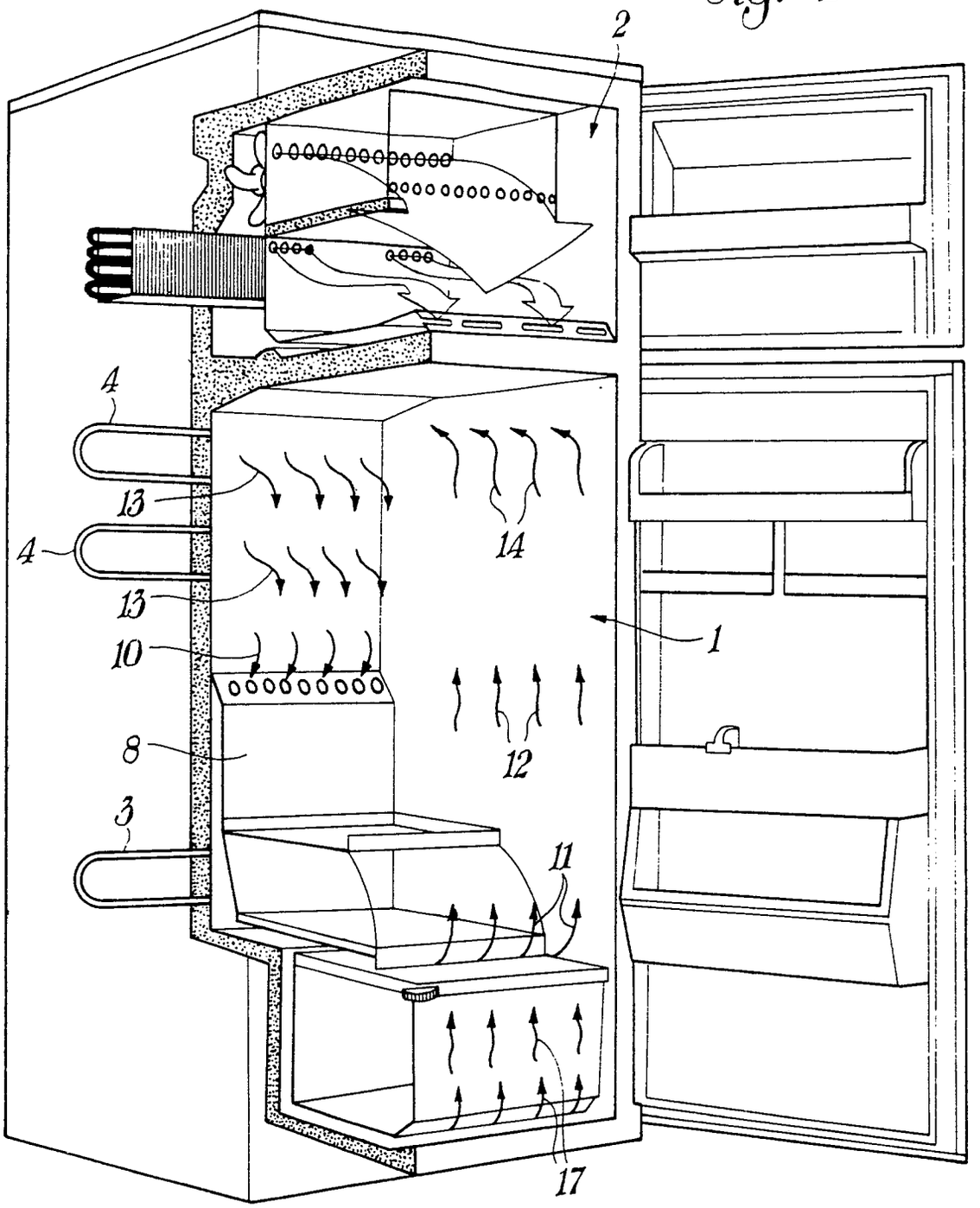



Fig. 1

Fig. 2



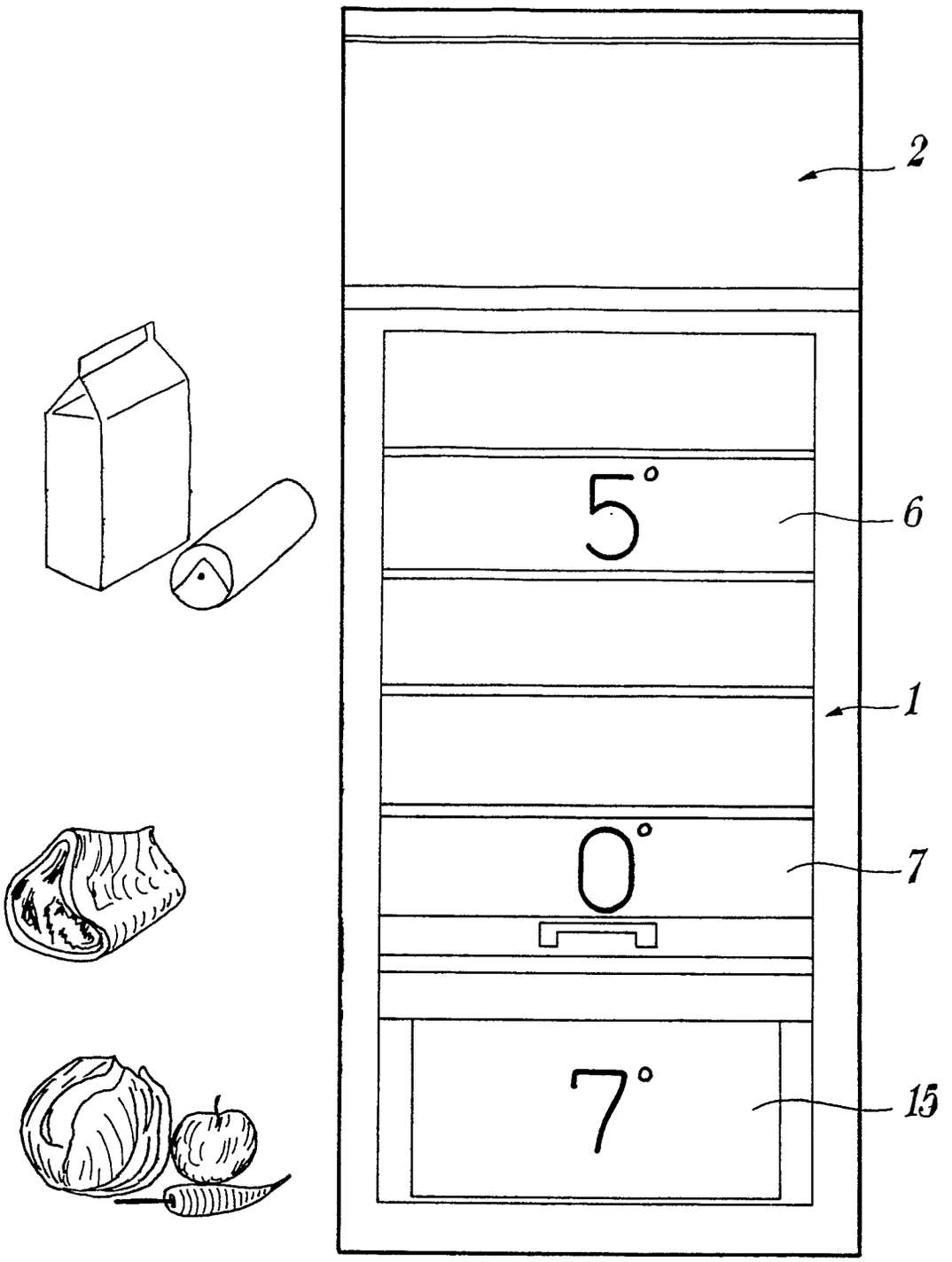



Fig. 3