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(54) **VACUUM STORAGE COMPARTMENT CONSTRUCTION IN A COOLING APPARATUS BODY**

VAKUUMLAGERFACHKONSTRUKTION FÜR KÜHLVORRICHTUNGEN

STRUCTURE DE COMPARTIMENT DE CONSERVATION SOUS VIDE DANS UN CORPS  
D'APPAREIL DE REFRIGERATION

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## Description

**[0001]** The present invention relates to a cooling apparatus body in accordance with the preamble of claim 1, known from EP-A-440 296, and has particular reference to vacuum storage compartment construction in a cooling apparatus body.

**[0002]** It has been proposed to include in cooling apparatus, particularly domestic refrigerators, freezers and refrigerator/freezer combinations, vacuum storage compartments for storage of foodstuffs in a vacuum environment. Such an environment offers the possibility of retarding deterioration of the stored products by, amongst other factors, reducing aerobic bacterial growth and photosynthesis. Compartments of that kind should preferably be evacuated automatically when products are placed in storage and returned to atmospheric pressure to allow removal of products via a closable access opening of the compartment. Accordingly, the compartments should be simple to evacuate and repressurise, capable of withstanding subatmospheric pressure levels in the order of 200 millibars absolute for lengthy periods of time and with repeated cycling, and relatively easy to keep hygienic and to clean. The need for sustained maintenance of an internal underpressure should be met in part by a minimum number of potential points of leakage. In wider terms, such compartments should be simple and economic to incorporate in the body of the cooling apparatus without introducing significant penalties in weight. They should also be efficient in their utilisation of the internal space of the apparatus so that the storage volume in the adjoining primary storage space at atmospheric pressure is not unduly compromised. Efficiency of space utilisation also applies to the compartment interior, which should not be diminished under the load caused by underpressure, in particular by inward deflection of boundary walls. Structural rigidity of the compartment is thus of substantial importance.

**[0003]** The principal object of the invention is therefore to provide a cooling apparatus body having a storage compartment which can be efficiently incorporated in a body of that kind at relatively low cost and which satisfies the need for sturdy construction and low risk of leakage.

**[0004]** Subsidiary objects of the invention include ease of cleaning and space-saving construction. Further objects and advantages of the invention will be apparent from the following description.

**[0005]** According to the present invention there is provided a cooling apparatus body comprising the features of claim 1.

**[0006]** Provision of a vacuum storage compartment in a cooling apparatus body, for example a body of a refrigerator, freezer or refrigerator/freezer combination, by integration in the thermal insulation element within the body represents a particularly economic approach to inclusion of such a storage facility. In effect, the usually necessary thermal insulation element is formed so as to bound the second compartment and to provide the major part of the

structural integrity necessary to resist the load induced by internal vacuum. The necessary hermetic enclosure of the vacuum storage compartment, apart from an access opening, is achieved by the hermetic liner. The liner, as a separately produced part, can easily be designed to have minimum potential leakage paths. Since the liner does not have to withstand the vacuum load unaided, it can be of relatively lightweight and even non-rigid construction, the internal load being transmitted to the lining via the bonded interface therewith.

**[0007]** Minimisation of points of leakage, particularly by elimination of joints, can be achieved in simple manner if the liner is an integrally formed component, preferably substantially box-shaped with mutually opposite side walls, a top wall, a bottom wall and a back wall. An integral box form can be produced inexpensively by, for example, injection moulding or blow moulding from plastics material. Points of possible leakage can be reduced to the region of door sealing at an access opening and the connections of ducts for supply and extraction of air. It is also advantageous if one or more of the junctions of the walls of the liner is or are radiused so as to avoid abrupt transitions, which assists maintenance of hygiene by reducing food traps and eases the task of cleaning.

**[0008]** At least part of the outer surface of the liner is structured to increase the surface area bonded with the respective surround, the structuring having the form of, for example, ribs. The increase in external surface area achieved by the structuring enhances the bond of the hermetic liner with its surround so that the resistance of the liner to buckling under internal load induced by underpressure is commensurately increased. The ribs also impart some degree of additional rigidity and structural strength to the liner regardless of the support provided by the bonded surround.

**[0009]** The liner is preferably made of plastics material, in which case the liner can be readily produced by, for example, injection moulding. A particularly suitable material is polystyrene. The liner can have a wall thickness of, for example, substantially three millimetres, which ensures sufficient stability of shape independently of the supporting surround and allows particularly economic manufacture of the liner.

**[0010]** The use of a separately constructed liner within the thermal insulation surround bounding the vacuum storage compartment also provides scope for integral formation of functional elements at the liner, for example guides for a drawer. In the case of injection-moulding or blow-moulding the liner from plastics material, the functional elements can thus be formed during the moulding process. Different internal fittings for such compartments can be achieved by use of different liners without necessarily changing the basic internal format of the cooling apparatus, in particular the thermal insulation element.

**[0011]** The material of the surrounds is preferably polyurethane. In one convenient embodiment, which is particularly economical in terms of utilisation of space, the surround of the first compartment and that of the second

compartment include a common partition separating the two compartments. The first compartment, which will normally have several times the volume of the second compartment, is preferably disposed above the latter. The surround of the first compartment is preferably lined by a lining, which for preference is made of polystyrene.

**[0012]** The second compartment is preferably closed by an own door accessible by way of a main door of the apparatus. The door individual to the second compartment can be carried by the above-mentioned drawer when that is present.

**[0013]** An embodiment of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a schematic side view of a refrigerator with a body embodying the invention; and

Fig. 2 is an exploded schematic perspective view, to enlarged scale, of the region of the storage compartment.

**[0014]** Referring now to the drawings there is shown in Fig. 1, in highly schematic form, a refrigerator 10 comprising a body 11 which is essentially formed by an external casing 12 of sheet metal internally lined by an insulating element 13 of thermal insulation material, in particular polyurethane having a thickness of about 20 millimetres, introduced - as explained further below - in liquid foam state. The element 13 is in turn lined by a lining 14 of polystyrene having a thickness of approximately 0.8 millimetres. The element 13 forms surrounds which bound a top compartment 15 for storage of items at atmospheric pressure, a middle, vacuum storage compartment 16 for storage of items at subatmospheric pressure and a bottom compartment 17 for storage of items again at atmospheric pressure, but, subject to appropriate structuring of the element 13, optionally at significantly reduced temperature relative to that present in the top compartment 15 so as to provide a facility for deep-freezing. The surrounds formed by the element 13 include a common wall portion separating the top and middle compartments 15 and 16 and a further common wall portion separating the middle and bottom compartments 16 and 17. The top and bottom compartments 15 and 17 include shelves, bins and other fittings, none of which is shown, conventionally present in a refrigerator.

**[0015]** The body 11 is fitted with a top door 18 and a bottom door 19 respectively providing access to the top compartment 15 and the bottom compartment 17. The middle compartment 16 is closed by an own door 20 accessible by way of the top door 18. The door 20 carries a seal, or co-operates with a seal, to provide hermetic closure of the middle, i.e. vacuum storage, compartment.

**[0016]** Also present in the body 11 is an enclosure 21 accommodating conventional components, schematically represented by the unit 22, of an evaporating and condensing circuit of the refrigerator as well as a vacuum

pump and associated ducts and control elements for the vacuum storage compartment 16.

**[0017]** The compartment 16 is lined by a separately constructed hermetic liner 23, which is shown in more detail in Fig. 2, to provide a hermetic barrier relative to the surround formed by the lining 13. The lining 14 is thus replaced by the liner 23 in the region of the compartment 16. The liner 23 is an integrally formed injection-moulded or blow-moulded lightweight component of polystyrene with a wall thickness of approximately 3 millimetres and has a box shape with two mutually opposite side walls, a top wall, a bottom wall and a back wall. An access opening is provided opposite the back wall, the opening being closed by the door 20. The junctions of all the walls of the liner 23 are radiussed so as to optimise the strength of liner by removing bend locations and to provide smooth uninterrupted internal wall transitions and thus eliminate traps for food residues as well as ease the task of cleaning.

**[0018]** The liner 23 is fixed in place by bonding to the constituent polyurethane material of the thermal insulation lining 13, as is the facing wall 14. More particularly, for construction of the body 11 of the refrigerator 10 the lining 14 and liner 23 as independent components are introduced into the sheet metal casing 12 at a predetermined spacing from the casing and from each other, the spacing between fixed by webs or other spacer elements at suitable positions. The space between the casing 12, lining 14 and liner 23 is then filled with polyurethane in liquid foam state. Hardening of the polyurethane creates the thermal insulation element 13 and produces an intimate bond with the lining 14 and liner 23. Due to this bond and the rigidity of the hardened thermal insulation element with the mentioned thickness of 20 millimetres, neither the lining 14 nor the liner 23 necessarily has to have a significant degree of inherent strength in terms of shape stability. The liner 23 can thus derive its resistance to the forces produced by the internal underpressure primarily from the rigidity of the surround formed by the element 13 and the bond with that surround whereby the liner can be of inexpensive, lightweight construction.

**[0019]** The external surface of the liner 23 includes integrally formed ribs 24 which have the effect of increasing the external surface area of the liner and thus the strength of the bond with the surround formed by the element 13. The ribs 24 additionally impart resistance to buckling of the walls of the liner 23 in the length direction of the ribs. The presence of the ribs 24 causes complementary grooves 25 to arise in the hardened material of the thermal insulating element 13.

**[0020]** The door 20 serving to close the vacuum storage compartment 16, thus the open side of the liner 23, can be made wholly or partly of glass so as to afford a view into the compartment. The door either carries a resilient seal which co-operates with the end face of the compartment surround formed by the element 13, so that the compartment can be securely hermetically sealed from the atmospheric pressure otherwise prevailing with-

in the refrigerator body 11, or co-operates with such a seal secured to the end face of the surround. The door 20 can be mounted on a drawer (not shown) which is slidably guided on runners 26 integrally formed at the inner surfaces of the two side walls of the liner 23. On opening of the door 20, the drawer slides out to provide easy access to items stored in the compartment 16.

**[0021]** The back wall of the liner 23 includes connections (not shown) for vacuum pipes, hoses or other conduits for extraction of air from the compartment in an evacuation phase, as well as maintenance of an evacuated state in a storage phase, and feed of air to the compartment to restore atmospheric pressure so as to allow opening of the door 20 for insertion and removal of items.

**[0022]** Use of the vacuum storage compartment 16 in operation of the refrigerator 10 is self-evident from the foregoing description. Access to the compartment 16 is gained by opening the external top door 18 after which, and following pressurisation of the compartment, the door 20 can be opened. After closure of the door 20, the compartment can be evacuated again. Pressurisation and evacuation can be controlled automatically by detectors responsive to operation of the door 20 and/or door 18 and to the pressure level. The detectors can be, for example, mechanical switches and pressure switches. Manually actuated switches can also be provided for control exclusively by a user and/or for overriding automatic operation.

**[0023]** The refrigerator body hereinbefore described incorporates a vacuum storage compartment which is integrated into the body in such a way as to make additional use of the thermal insulation element that is normally provided. Resistance to the loading induced by the underpressure created in the compartment is achieved by the rigid compartment surround formed by the element. Hermetic enclosure of the compartment, apart from the access opening, is provided by the separately constructed liner. The liner can be designed, by way of integral construction, appropriate shaping and suitable selection of material, to be sufficiently form-stable to the extent necessary for the production phase of embedding in liquid foam thermal insulation material and in use to offer few points of potential vacuum leakage. Features such as drawer guides can be readily incorporated in the liner at the time of manufacture. An integrated compartment of such a construction thus represents an economic method of providing a vacuum storage facility in mass-produced refrigerators and other cooling apparatus.

## Claims

1. A cooling apparatus body (11) having a top compartment (15) and a bottom compartment (17) intended for storage at atmospheric pressure and a middle vacuum storage compartment (16) intended for storage below atmospheric pressure, wherein the middle vacuum storage compartment (16) is closed by

an own door (20) accessible by way of a main door (18) of the apparatus (10), the compartments (15, 16, 17) being surrounded by surrounds formed by an internal thermal insulation element (13),

**characterised in that** said middle vacuum storage compartment (16) being lined within the respective surround by a separately constructed hermetic liner (23) bonded to that surround, wherein the liner (23) is an integrally formed component, wherein at least part of the outer surface of the liner (23) is structured to increase the surface area bonded with the respective surround, and wherein the structuring is provided by ribs (24).

2. A body as claimed in claim 1, wherein the liner (23) is substantially box-shaped with mutually opposite side walls, a top wall, a bottom wall and a back wall.

3. A body as claimed in claim 2, wherein at least one of the junctions of the walls is radiused.

4. A body as claimed in any one of the preceding claims, wherein the liner (23) is made of plastics material.

5. A body as claimed in claim 4, wherein the plastics material is polystyrene.

6. A body as claimed in any one of the preceding claims, wherein the liner (23) has a wall thickness of three millimetres.

7. A body as claimed in any one of the preceding claims, wherein the liner (23) has integrally formed functional elements, wherein the functional elements comprise guides (26) for a drawer of the middle vacuum storage compartment (16).

8. A body as claimed in any one of the preceding claims, wherein the thermal insulation element (13) comprises polyurethane.

9. A body as claimed in any one of the preceding claims, wherein the surrounds of the top compartment (15) or bottom compartment (17) and the middle vacuum storage compartments (16) include a common partition separating the compartments.

10. A body as claimed in any one of the preceding claims, wherein the surround of the top compartment (15) and the bottom compartment (17) is lined by a lining (14).

11. A body as claimed in claim 10, wherein the facing wall of the lining (14) is of polystyrene.

12. Cooling apparatus (10) comprising a body (11) as claimed in any one of the preceding claims.

13. Apparatus as claimed in claim 12, wherein the apparatus is a refrigerator, a freezer or a refrigerator/freezer.

### Patentansprüche

1. Kühlgerätkörper (11) mit einem oberen Fach (15) und einem unteren Fach (17), die für die Lagerung bei Atmosphärendruck bestimmt sind, und mit einem mittleren Vakuumlagerfach (16), das für die Lagerung unterhalb Atmosphärendruck bestimmt ist, wobei das mittlere Vakuumlagerfach (16) durch eine eigene Tür (20) verschlossen ist, die über eine Haupttür (18) des Geräts (10) zugänglich ist, wobei die Fächer (15, 16, 17) von Einfassungen, die durch ein inneres Wärmedämmelement (13) gebildet sind, eingefasst sind, **dadurch gekennzeichnet, dass** das mittlere Vakuumlagerfach (16) in der jeweiligen Einfassung mit einer separat konstruierten hermetischen Einlage (23) ausgekleidet ist, die mit dieser Einfassung gebunden ist, wobei die Einlage (23) eine integral ausgebildete Komponente ist, wobei mindestens ein Teil der äußeren Oberfläche der Einlage (23) so strukturiert ist, dass die mit der entsprechenden Einfassung gebundene Oberfläche vergrößert wird, und wobei die Strukturierung durch Rippen (24) bereitgestellt ist.
2. Körper nach Anspruch 1, wobei die Einlage (23) im Wesentlichen kastenförmig ist, mit sich gegenseitig gegenüberliegenden Seitenwänden, einer oberen Wand, einer unteren Wand und einer hinteren Wand.
3. Körper nach Anspruch 2, wobei mindestens einer der Übergänge der Wände abgerundet ist.
4. Körper nach einem der vorhergehenden Ansprüche, wobei die Einlage (23) aus Kunststoffmaterial hergestellt ist.
5. Körper nach Anspruch 4, wobei das Kunststoffmaterial Polystyrol ist.
6. Körper nach einem der vorhergehenden Ansprüche, wobei die Einlage (23) eine Wanddicke von drei Millimetern hat.
7. Körper nach einem der vorhergehenden Ansprüche, wobei die Einlage (23) integral ausgebildete Funktionselemente hat, wobei die Funktionselemente Führungen (26) für eine Schublade des mittleren Vakuumlagerfachs (16) umfassen.
8. Körper nach einem der vorhergehenden Ansprüche, wobei das Wärmedämmelement (13) Polyurethan umfasst.

9. Körper nach einem der vorhergehenden Ansprüche, wobei die Einfassungen des oberen Fachs (15) oder des unteren Fachs (17) und der mittleren Vakuumlagerfächer (16) eine gemeinsame Abtrennung aufweisen, die die Fächer trennt.

10. Körper nach einem der vorhergehenden Ansprüche, wobei die Einfassung des oberen Fachs (15) und des unteren Fachs (17) mit einer Auskleidung (14) ausgekleidet ist.
11. Körper nach Anspruch 10, wobei die Außenwand der Auskleidung (14) aus Polystyrol ist.
12. Kühlgerät (10) mit einem Körper (11) nach einem der vorhergehenden Ansprüche.
13. Gerät nach Anspruch 12, wobei das Gerät ein Kühlgerät, ein Gefriergerät oder eine Kühl-/Gefrierkombination ist.

### Revendications

1. Corps d'appareil de refroidissement (11) comprenant un compartiment supérieur (15) et un compartiment inférieur (17) destinés au stockage à la pression atmosphérique et un compartiment médian de stockage sous vide (16) destiné au stockage au-dessous de la pression atmosphérique, dans lequel le compartiment médian de stockage sous vide (16) est fermé par une porte (20) qui lui est propre et accessible par l'intermédiaire d'une porte principale (18) de l'appareil (10), les compartiments (15, 16, 17) étant entourés par des bordures formées par un élément d'isolation thermique interne (13), **caractérisé en ce que** ledit compartiment médian de stockage sous vide (16) est revêtu, à l'intérieur de la bordure respective, d'un revêtement hermétique fabriqué séparément (23) collé à cette bordure, dans lequel le revêtement (23) est un élément formé de manière intégrale, dans lequel au moins une partie de la surface extérieure du revêtement (23) est structurée pour augmenter la surface collée à la bordure respective et dans lequel ce sont des nervures (24) qui fournissent la structure.
2. Corps selon la revendication 1, dans lequel le revêtement (23) a essentiellement la forme d'une boîte, avec des parois latérales en opposition mutuelle, une paroi supérieure, une paroi inférieure et une paroi postérieure.
3. Corps selon la revendication 2, dans lequel au moins une des jonctions des parois est arrondie.
4. Corps selon l'une quelconque des revendications précédentes, dans lequel le revêtement (23) est for-

mé d'une matière plastique.

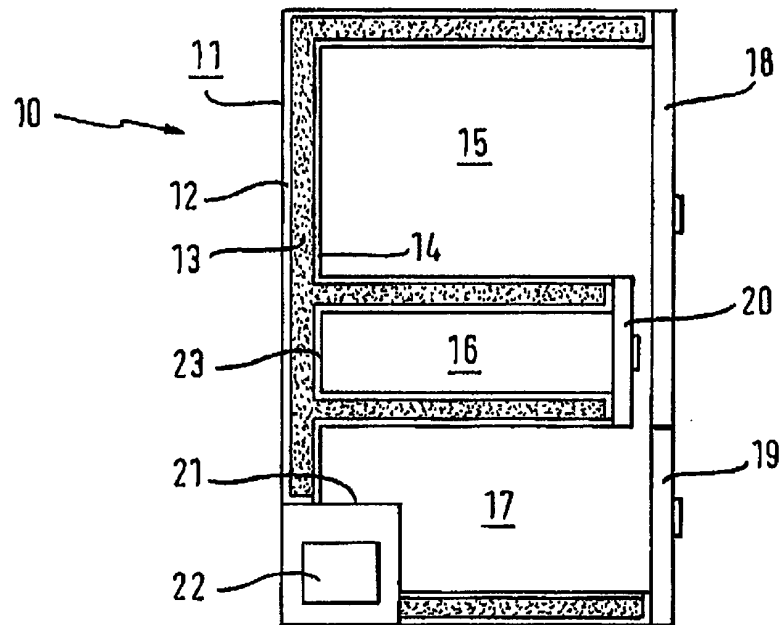
5. Corps selon la revendication 4, dans lequel la matière plastique est le polystyrène. 5
6. Corps selon l'une quelconque des revendications précédentes, dans lequel le revêtement (23) a une épaisseur de paroi de trois millimètres.
7. Corps selon l'une quelconque des revendications précédentes, dans lequel le revêtement (23) comprend des éléments fonctionnels formés de manière intégrale, dans lequel les éléments fonctionnels comprennent des guides (26) pour un tiroir du compartiment médian de stockage sous vide (16). 10  
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8. Corps selon l'une quelconque des revendications précédentes, dans lequel l'élément d'isolation thermique (13) comprend du polyuréthane. 20
9. Corps selon l'une quelconque des revendications précédentes, dans lequel les bordures du compartiment supérieur (15) ou du compartiment inférieur (17) et du compartiment médian de stockage sous vide (16) incluent une cloison commune séparant les compartiments. 25
10. Corps selon l'une quelconque des revendications précédentes, dans lequel la bordure du compartiment supérieur (15) et du compartiment inférieur (17) est pourvue d'un revêtement (14). 30
11. Corps selon la revendication 10, dans lequel la paroi frontale du revêtement (14) est en polystyrène. 35
12. Appareil réfrigérant (10) comprenant un corps (11) selon l'une quelconque des revendications précédentes.
13. Appareil selon la revendication 12, dans lequel l'appareil est un réfrigérateur, un congélateur ou un réfrigérateur/congélateur. 40

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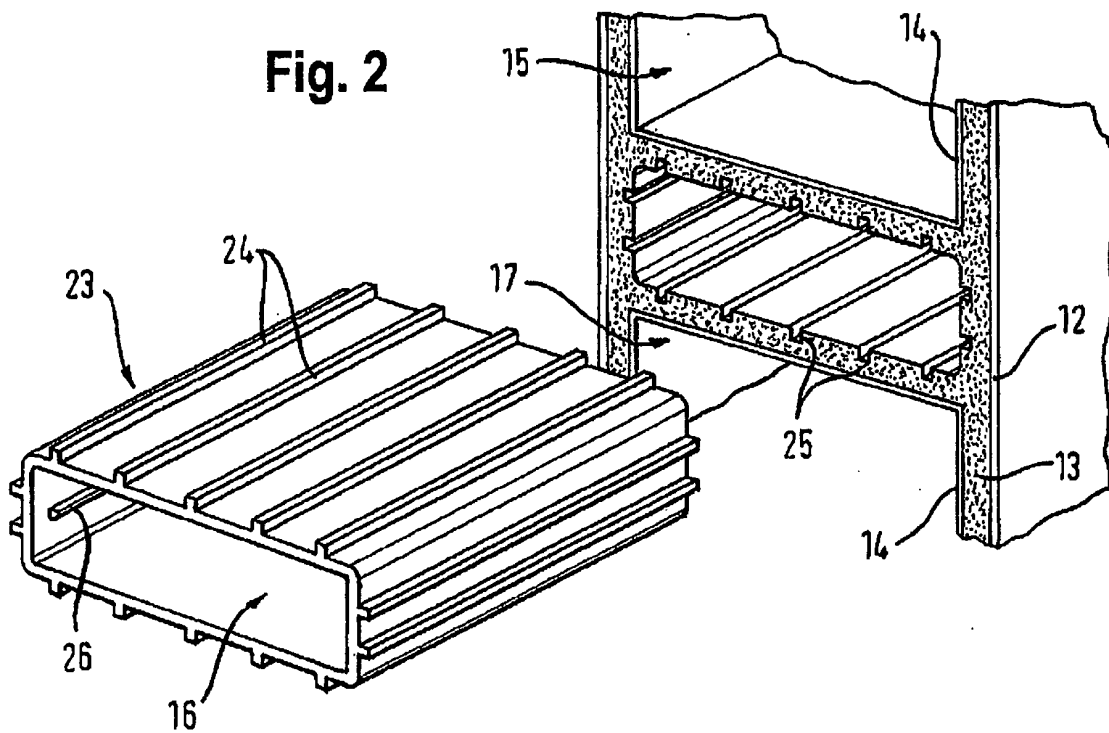
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**Fig. 1**



**Fig. 2**



**REFERENCES CITED IN THE DESCRIPTION**

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