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(54) Refrigeration apparatus with two storage compartments on top of each other and a fan-assisted evaporator

(57) Refrigeration apparatus comprising: - at least an upper storage compartment (1) and at least a lower storage compartment (2), - a partition wall (5) between said two compartments (1,2), provided with a through-aperture between said compartments (1,2), - a vertical conduit (6) on the rear wall (7) connecting said two compartments (1,2) with each other, - a single evaporator (11), - a fan (8) arranged at the upper intake mouth (9) of said conduit (6), in which said evaporator (8) is of the finned-tube battery kind and is positioned in front of the lower outflow mouth (10) of said conduit (6).
The finned-tube battery-type evaporator (8) is housed in a receptacle (12) that is open towards the lower compartment (2) and arranged at the lower mouth (10) of the vertical conduit (6). Preferably, a connection piece (13) having a flared shape on the side facing the evaporator (8) is provided between the conduit (6) and the receptacle (12).

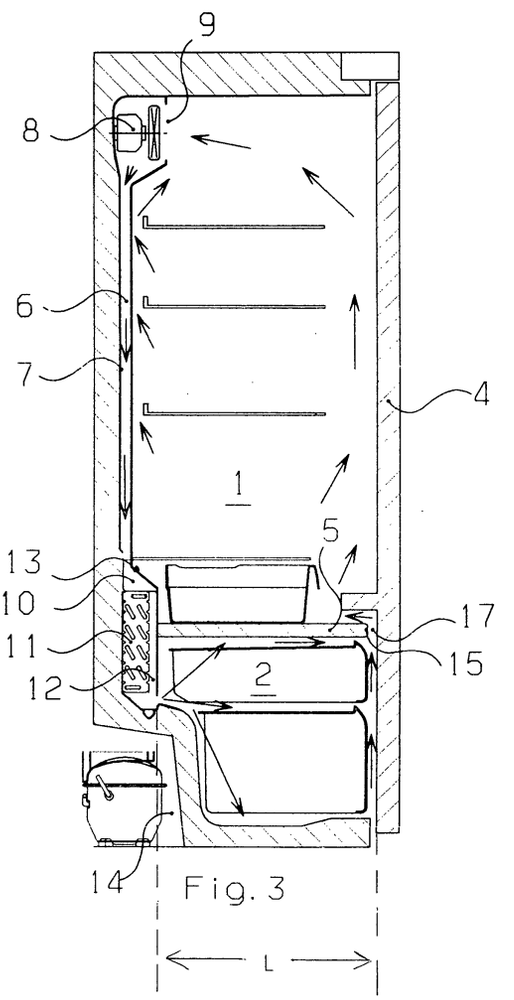

Fig. 3

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Description

[0001] The present patent application refers to an improved type of refrigeration apparatus provided with two cold storage compartments arranged on top of each other and cooled by a same fan-assisted evaporator battery.

[0002] Largely known in the art are refrigeration appliances provided with two storage compartments that are cooled in an interdependent manner by a single and same evaporator arranged in one of said storage compartments and exposed to a flow of forced air, in such a manner as to enable the resulting cooled air to be forced into flowing, via appropriate conduits, through both said compartments in a sequence, before being sent again back towards the evaporator.

[0003] Known from the disclosure in GB 1485666 is a refrigeration apparatus comprising a lower freezer compartment and an upper refrigerated, i.e. cold storage compartment, in which said two compartments are separated from each other by a horizontal partition wall.

[0004] The evaporator is of the "roll-bond" type and is provided in a corner-like arrangement in the lower freezer compartment, from which there departs a vertical conduit connecting this compartment with the upper zone of the compartment arranged thereupon. In order to cause the cold air to circulate from the freezer compartment to the refrigerated compartment, said vertical conduit is provided with an appropriate fan, and said horizontal partition wall is in turn provided of an appropriate through-aperture for the return flow of the air, i.e. the flow of air moving back to the evaporator. The control of the temperatures in the two compartments is ensured by means of at least two thermostats provided in the respective compartments and appropriately connected with the control arrangement provided to switch the fan on and off.

[0005] Such a solution, however, has a major drawback in that the planar configuration of the evaporator uses a lot of space and, furthermore, the control of the widely differing temperatures in the two compartments cannot be always effectively ensured and maintained to the required extent of accuracy by simply balancing the operation of the evaporator based on the temperatures prevailing in the two compartments.

[0006] Known from the disclosure in the patent application EP 0793066 is a refrigeration apparatus comprising a lower low-temperature, i.e. freezing compartment and an upper refrigerated compartment that are again separated from each other by a horizontal wall.

[0007] The evaporator is of the "roll-bond" type with a planar configuration and is arranged inside a vertical conduit which connects the upper compartment to the lower compartment and extends through said horizontal partition wall. The circulation of the air from and to the two compartments is not only ensured by said conduit passing through the partition wall, but also by a further aperture provided in the horizontal wall at a short distance from the door of the appliance, as well as by a fan that is arranged at the upper mouth of said vertical conduit.

[0008] The evaporator is located at the height of the upper compartment; however, the cooled air first flows through the lower freezing compartment and then returns, at a lower temperature, to the upper compartment.

[0009] Such a solution, albeit functioning quite well, has however a major drawback in that said evaporator, and therefore the conduit in which it is housed, is as wide as the rear wall of the appliance, hence taking up a lot of space. Furthermore, the outer rear wall of the upper compartment must be adequately insulated in order to avoid wasting the cold being transmitted by the adjacent conduit containing the evaporator.

[0010] Known from the disclosure in EP 0 532 870 is a refrigeration apparatus that is substantially similar to the one described above, from which it differs due to the fact that its planer evaporator is of the so-called "concealed" type, i.e. of the type embedded in the rear wall of the upper compartment of the appliance. This solution, while improving the way in which space is used, makes on the other hand it necessary for an increased or additional insulation to be provided for said wall, in view of preventing too many frigories, i.e. too much an amount of cold from leaking outside. In addition, the apertures provided for taking in the air from the upper refrigerated compartment are in the number of two and are arranged laterally with the related conduits. This practically means that more space is used up inside the refrigerated storage compartment, so that there is less space available to actual storage purposes.

[0011] It therefore would be desirable, and it is actually a main purpose of the present invention to provide a refrigeration apparatus, preferably for residential use, i.e. of the household type, that is provided with two distinct storage compartments arranged on top of each other, i.e. an upper cold storage compartment and a lower compartment for storing food at a lower temperature, preferably at approx. 0°C, which do away with all of the afore described drawbacks, while at the same time enabling the availability of space actually utilizable to storage purposes to be improved, through the use of a single evaporator and by forcing the air to circulate throughout both compartments.

[0012] In addition, such an apparatus shall be capable of being easily implemented and manufactured with the use of existing, readily available techniques, and shall be competitive in both its construction and its use. In particular it shall be capable of using a single and same refrigerating circuit as a source of cold.

[0013] According to the present invention, these aims are reached in a particular type of refrigeration apparatus that is suitably provided with a battery-type evaporator and a related channel for circulating the forced air flow, so as this is described below by mere way of non-limiting example with reference to the accompanying

drawings, in which:

- Figure 1 is a vertical cross-sectional side view of a schematically illustrated embodiment of a refrigeration apparatus according to the present invention;

- Figure 2 is a view similar to the one appearing in Figure 1 of an improved embodiment of the refrigeration apparatus of the invention;

- Figure 3 is a view similar to the one shown in Figures 1 and 2 of a further improved embodiment of the refrigeration apparatus according to the present invention;

- Figure 4 is a front view of the inner rear wall of the upper storage compartment of a refrigeration apparatus according to the present invention; and

- Figure 5 is a view along the horizontal F - F section of the upper storage compartment of Figure 4.

[0014] A refrigeration apparatus according to the present invention comprises an upper storage compartment 1, a lower storage compartment 2, an outer casing provided with an insulated rear wall 3, at least a door 4 providing access to said compartments, which are separated from each other by a partition wall 5, a vertical conduit 6 located in proximity of the inner rear wall 7 of said upper compartment and connecting said two compartments with each other, and a fan 8 arranged in correspondence of the intake mouth 9 of said conduit, in which said mouth is provided on top of said conduit and lies in the upper zone of said upper compartment 1.

[0015] According to the present invention, the lower outflow mouth 10 of said conduit is directed towards an evaporator 11 of the finned-tube battery kind, and means are provided that are adapted to ensure that all of the air leaving said evaporator after having so been cooled down by it is actually let solely and only into said lower compartment 2.

[0016] Such means preferably, and most generally, include the fact that said evaporator 11 is located inside said lower compartment 2, i.e. below the level of said partition wall 5, and said conduit 6 extends therefore downwards, at least to such an extent as to enter said lower compartment.

[0017] It will anyway be appreciated that other embodiments and solutions can of course be figured out in view of ensuring that the whole air circulation flow between the two storage compartments is also used to ventilate the evaporator.

[0018] The finned-tube battery-type evaporator is largely known in the art, so that it shall not be described here any further.

[0019] The utilization od such an evaporator in this particular case is justified by the fact that, as all those skilled in the art are well aware of, it is capable of ensuring the same heat-exchange capacity as a traditional evaporator, either of a coil-type or a "roll-bond" type, while however taking up much less space.

[0020] This of course enables the space available to actual storage purposes to be significantly increased. However, for it to prove really effective, a finned-tube battery-type evaporator must notoriously be ventilated and this most obviously requires the provision of a suitable, albeit small-sized fan, which anyway means additional costs and construction complications.

[0021] A further advantage ensured by the present invention lies therefore in the fact that, thanks to the invention, use is made to this purpose of the existing fan provided to ensure the circulation of the cold air between the two storage compartments, so that, with this solution, it is actually a single fan that is advantageously used to perform two different and independent tasks, i. e.:

- circulating the cold air between the two distinct storage compartments,

- ventilating the finned-tube battery-type evaporator.

[0022] With reference to Figure 2, which illustrates a preferred embodiment of the present invention, the evaporator 11 is housed in a receptacle 12 into which debouches the lower outflow mouth 10 of said conduit 6; said receptacle is open downwards and is so shaped as to quite tightly enclose said evaporator, so that substantially all air flowing from said counduit is forced to pass through the battery-type evaporator 11, thereby optimizing the heat-exchange efficiency thereof.

[0023] A useful improvement of the present invention is obtained if the portion of conduit that acts as a connection between the upper conduit and said receptacle 12 is so shaped as to show a tapered portion 13, so as this is illustrated in Figure 2. Such a conformation of the conduit, in fact, enables the uniformity of the air flow, and therefore of the air flow-rate through the entire thickness of the finned battery, to be facilitated, thereby further improving the heat-exchange process.

[0024] A further improvement is obtained with the following configuration: since the lower portion of the refrigeration apparatus is in fact usually occupied by the compressor and other functional parts of the apparatus, the embodiments illustrated in Figures 1 and 2 would practically not prove very expedient, since the battery-type evaporator would in these cases occupy the space normally intended to accommodate said component parts. In view of being able to keep the compressor sited in its usual lower outer receptacle 14, near the rear wall of the apparatus, it proves advantageous to have said battery-type evaporator sited above said receptacle 14, as best illustrated in Figure 3.

[0025] The need therefore arises for said finned-tube battery evaporator to be raised up to a higher level than said partition wall 5 and be so positioned as to lie behind

the latter. However, such an adaptation can be easily obtained if a receptacle is used to accommodate the battery-type evaporator, which is effective in preventing the air flow from directly entering the upper compartment 1, while on the contrary forcing said flow to anyway move through the entire evaporator battery and then enter completely the lower compartment 2.

[0026] Referring again to Figure 3, a last improvement is obtained if the passage of the air from the lower compartment 2 into the upper compartment 1, which must in all cases be ensured so as to allow the air flow to cover the return path thereof and, therefore, keep it duly circulating all the time, is not achieved through the provision of a dedicated aperture in said partition wall 5, but rather by providing an appropriate recess, that will be as wide as needed and, in this connection, may extend to even cover the whole width of the compartments, along the front portion 15 of said partition wall.

[0027] By suitably sizing the corresponding inner wall, i.e. the liner of the outer door 4, a passage 17 is actually obtained between said inner wall, or door liner, and said partition wall 5, and this passage provides the required communication between the storage compartments for the air flow to be able to follow its return path into the upper compartment.

[0028] Such a solution has a twofold advantage in that it introduces a simplification from a construction point of view, while at the same time ensuring a circulation of the cold air in the lower compartment throughout the depth "L" thereof, unlike what would most probably, if not even certainly occur in the case that such a passage of the air between the two compartments is provided in the form of an aperture in a central position of said partition wall 5.

[0029] Finally, given the compact size of the evaporator battery, it proves expedient if the conduit 6 does not feature a large front surface, that would take up a lot of space, but is rather provided as a simple channel or duct 16 with a rectangular or markedly elongated cross-section, arranged in an approximately central position on the rear wall, as this is best shown in Figures 4 and 5.

[0030] With such a conformation, said duct can be used to easily insert some possible air-handling provisions 18, such as deodorizers, sterilizers, ionizers or the like, in the same duct, while this is largely known to be by far more difficult in the case of a duct sized to an extremely flattened shape, so as it is used in the prior art.

Claims

1. Two-temperature refrigeration apparatus, particularly for home use, comprising:

   - at least an upper inner compartment (1) for storing food at refrigeration temperature,
   - at least a lower inner compartment (2) for storing food at lower temperatures,
   - a partition wall (5) separating said compartments from each other,
   - at least an aperture between said two compartments,
   - a vertical conduit (6) arranged on the back wall (7) and connecting said two compartments with each other,
   - a single evaporator unit arranged within said refrigeration apparatus,
   - a fan (8) situated in the upper intake mouth (9) of said conduit,

   characterized in that

   - said evaporator unit is of the finned-tube battery type (11),
   - said finned-tube battery is positioned in front of the lower outflow mouth (10) of said conduit, so that said fan is capable to both generate a forced flow of air through said evaporator unit and to circulate the air between said two compartments.

2. Refrigeration apparatus according to claim 1, **characterized in that** said finned-tube battery-type evaporator is accommodated in a receptacle (12) that is open towards said lower compartment and arranged in correspondence of the lower outflow mouth (10) of said vertical conduit.

3. Refrigeration apparatus according to claim 2, **characterized in that** there is provided a connection piece between said conduit and said receptacle having, and that said connection pice (13) has a downward flared shape and is preferably oriented towards the upper portion of said finned-tube battery evaporator.

4. Refrigeration apparatus according to any of the preceding claims, **characterized in that** said receptacle (12) is arranged in a manner in which is substantially adheres against the insulated rear wall (3) of said apparatus.

5. Refrigeration apparatus according to any of the preceding claims, **characterized in that** said two compartments are closed by a same door (4), and that said aperture between said two compartments is implemented as a passage (17) for the return flow of air from the lower compartment to the upper compartment, in the form of an appropriate shape given to the front portion (15) of said partition wall and the corresponding zone of the inner wall or liner of said door (4).

6. Refrigeration apparatus according to any of the preceding claims, **characterized in that** said vertical conduit (6) only adheres against a portion of the

back wall of said upper compartment, and that it has a parallelepiped-like or a markedly elongated shape.

7. Refrigeration apparatus according to any of the preceding claims 2 to 6, **characterized in that** at least a part of the internal volume of said receptacle (12) is situated in a higher position than said partition wall (5) separating said two compartments from each other.

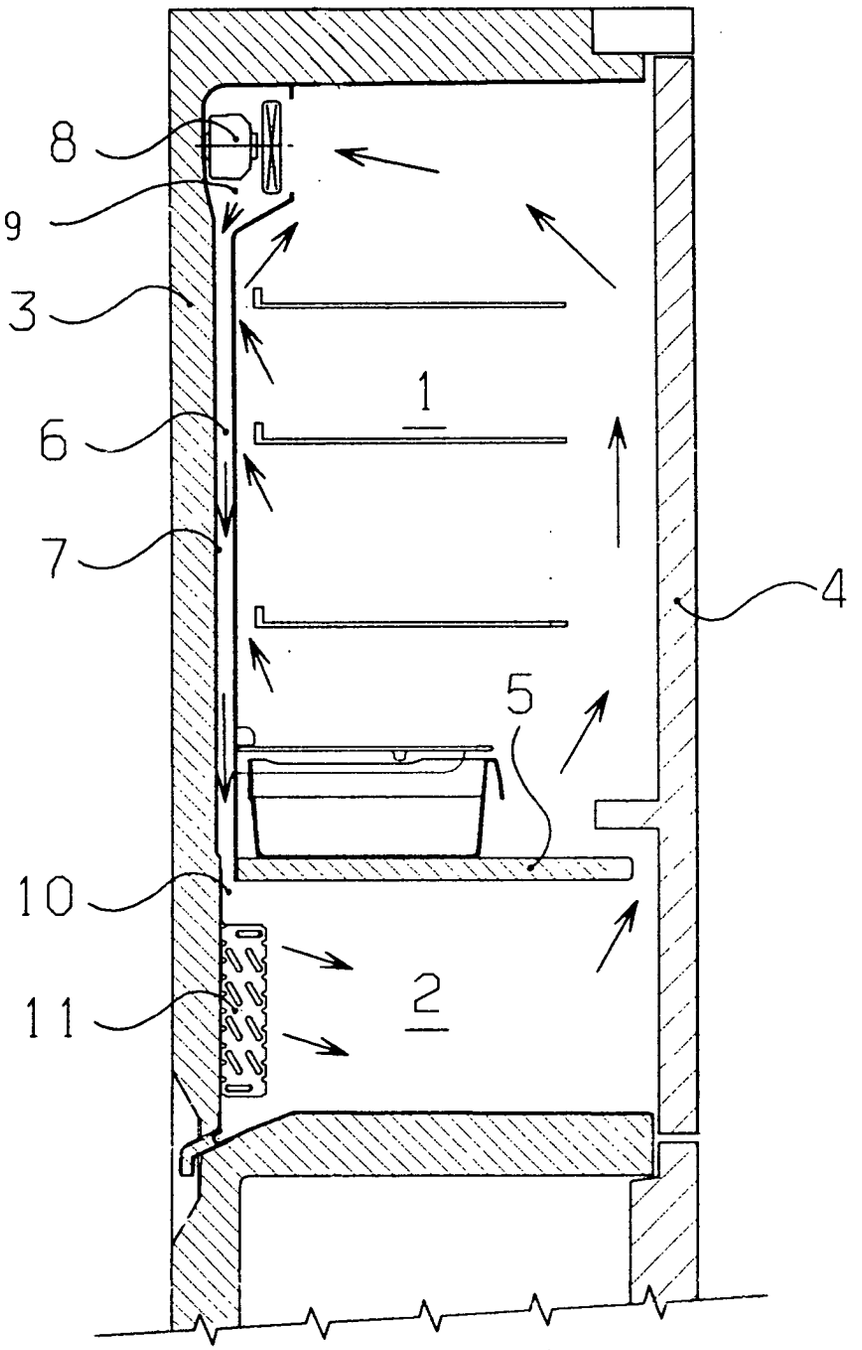


Fig. 1

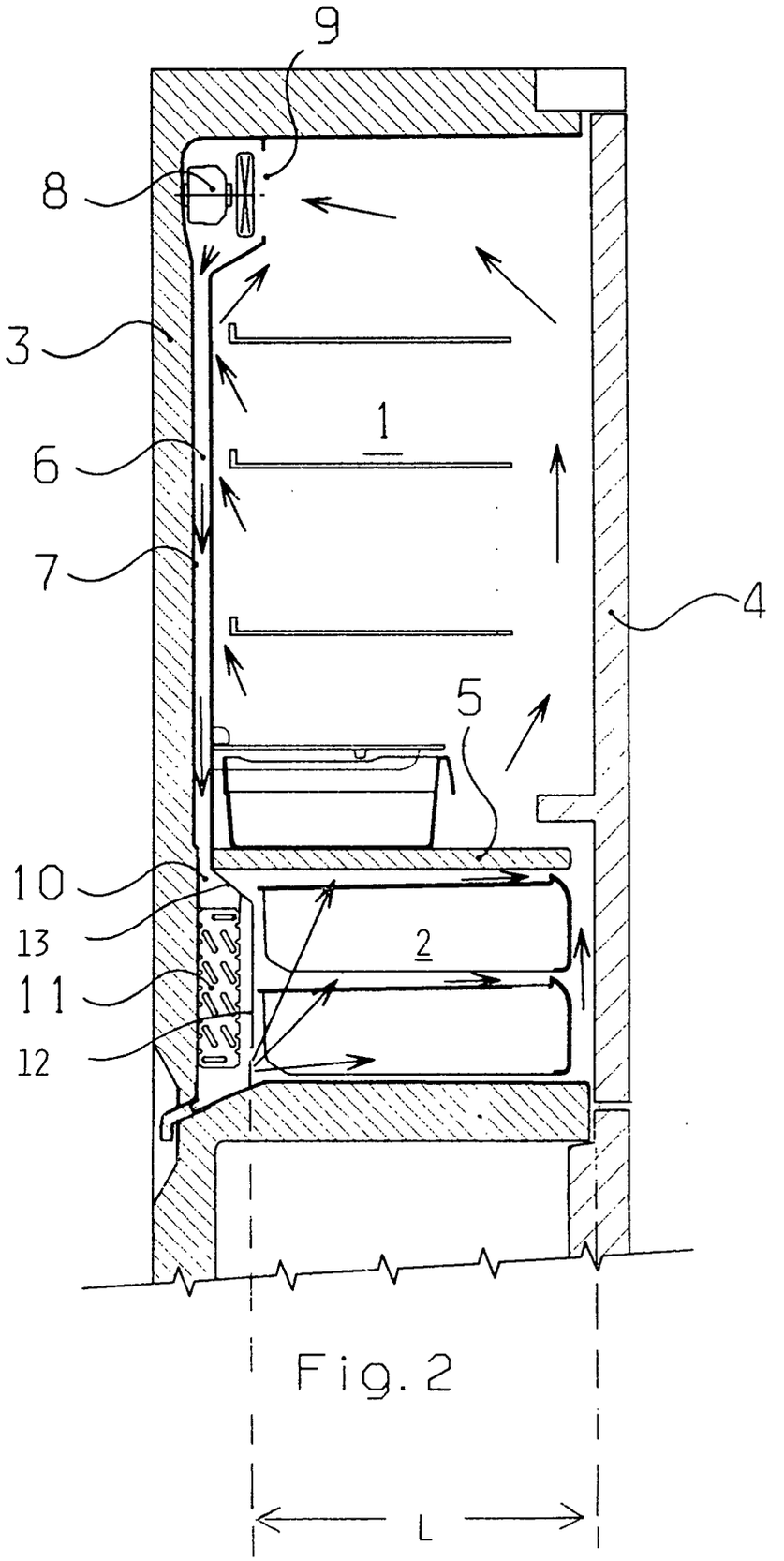


Fig. 2

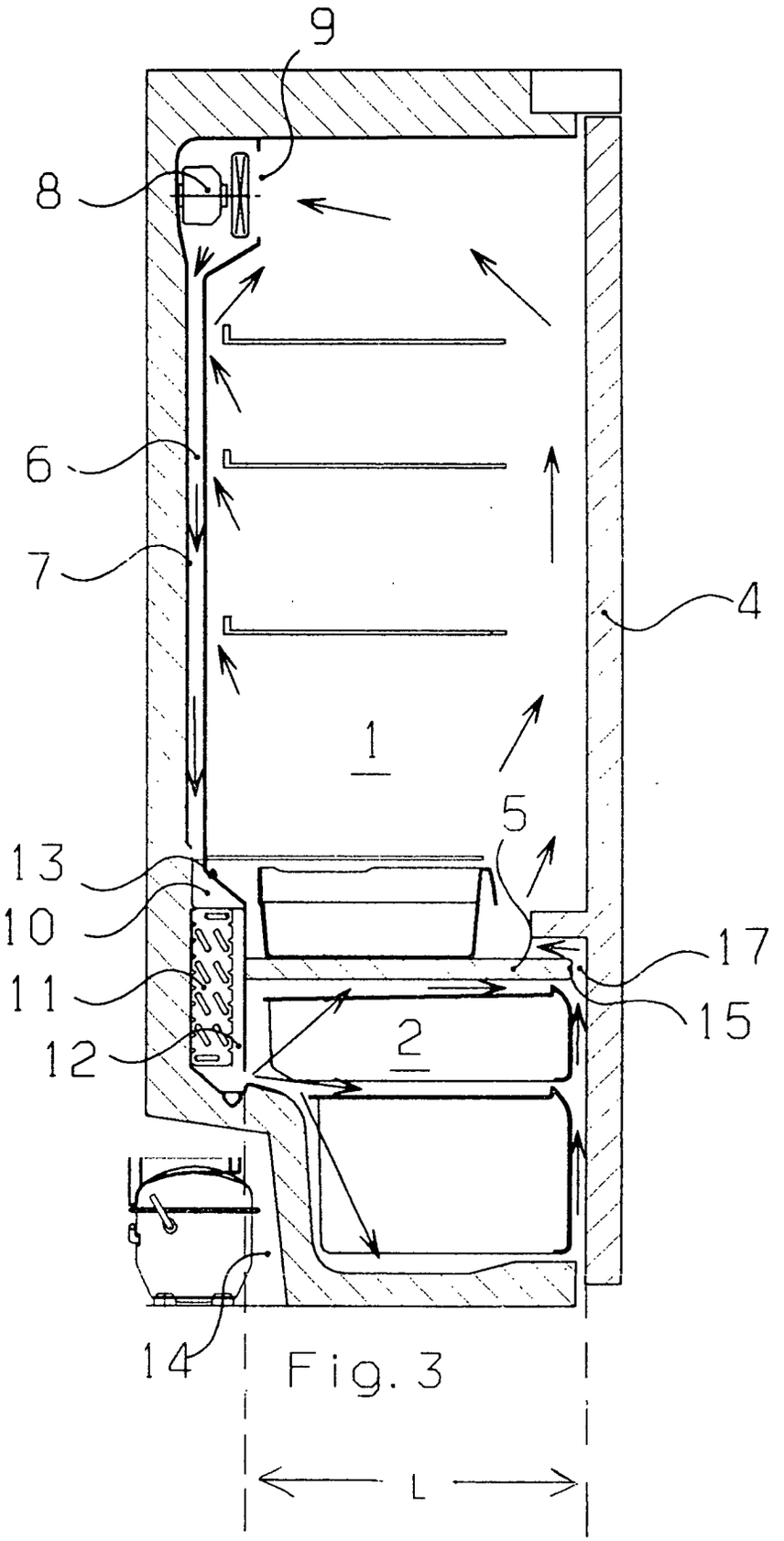


Fig. 3

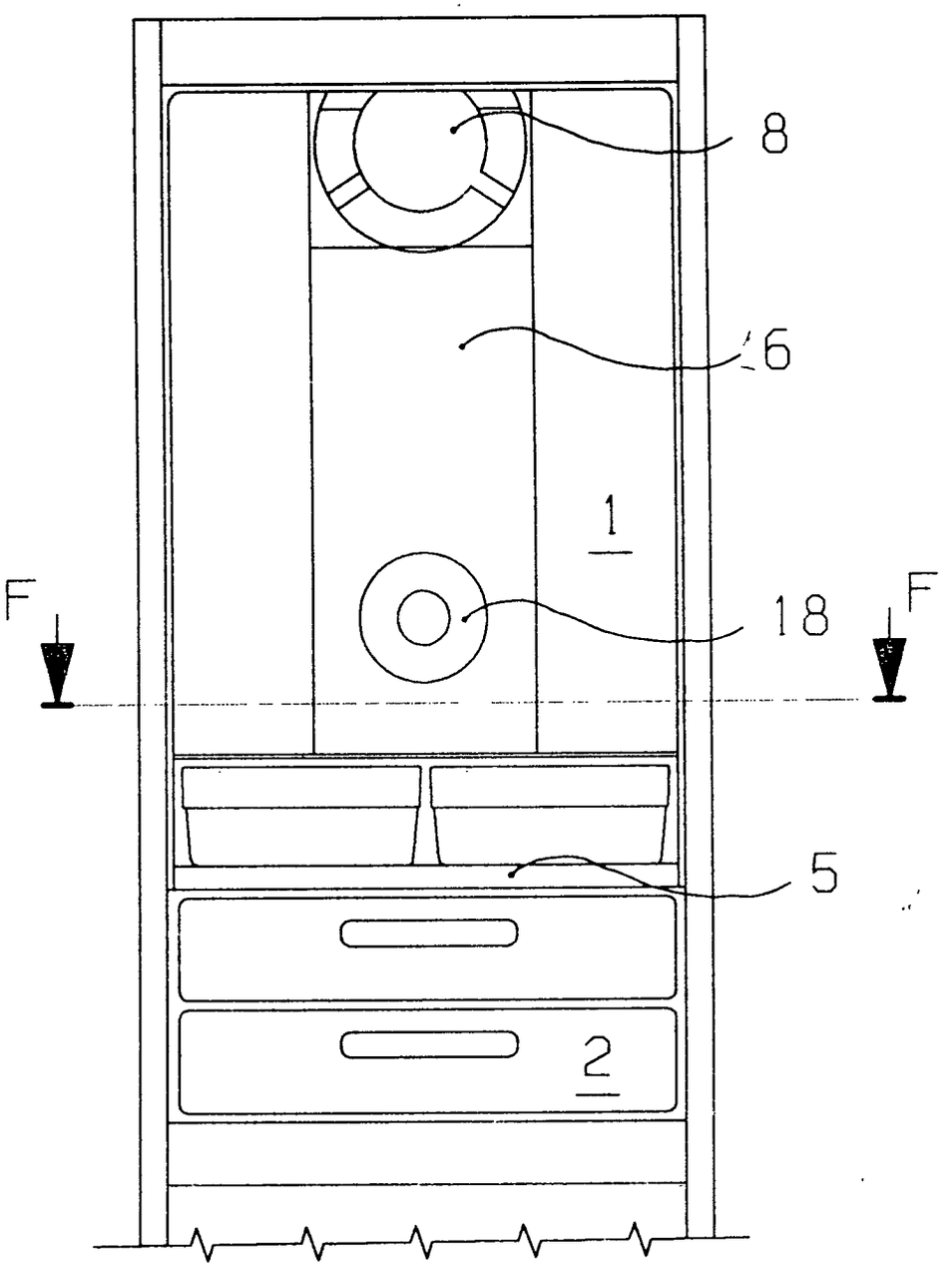
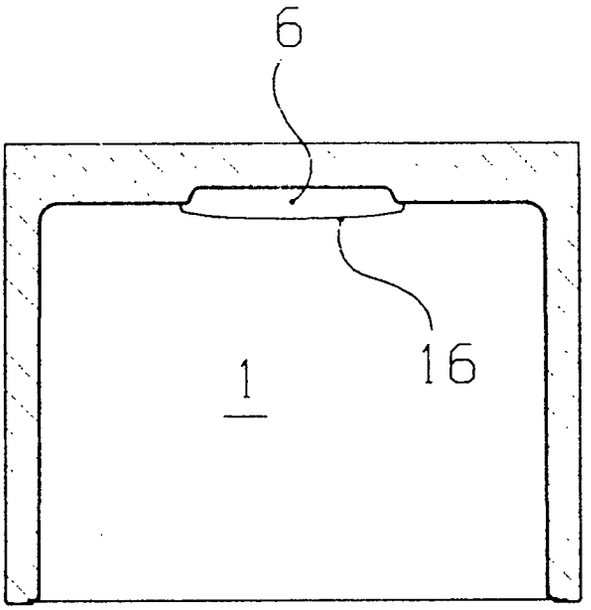


Fig. 4



Section F-F

Fig. 5