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(54) Compact-dimension device for sensing frost on a refrigerator evaporator

(57) A device (6) for sensing frost on a refrigerator evaporator (1), comprising at least one frost sensor (7), preferably of capacitive type, and an interface unit (8) arranged to polarize the sensor (7) so as to determine its capacitance change and make this acceptable by a usual unit for controlling the defrosting of the evaporator (1); said frost sensor (7) and said interface unit (8) are associated with a flexible support (10) and are directly connected together.

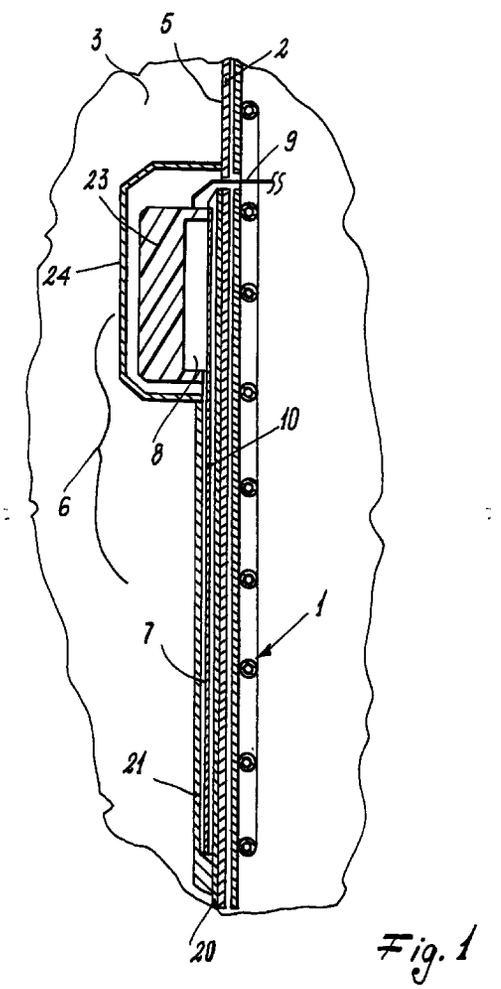

Fig. 1

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Description

This invention relates to a device in accordance with the introduction to the main claim.

Frost sensors in particular of capacitive type are known. Such sensors are usually positioned within a refrigerator compartment in correspondence with the evaporator (either directly on it or on a wall of the refrigerator compartment behind which the evaporator is situated, depending on the type of construction of this latter). During normal operation of the refrigerator the frost deposits on the sensor, of which, as the frost thickness on it varies, a suitable intrinsic electrical characteristic, in this case its capacitance, changes. This change in the said characteristic or capacitance is proportional to the variation in the frost layer. Said variation is sensed by a control unit which in known manner calculates the frost layer present on the evaporator and, when necessary, proceeds to halt this latter and defrost it. In order to enable the control unit to accept the signals emitted by the frost sensor, a known interface unit is provided between said sensor and said control unit.

In known arrangements, the frost sensor is positioned within the refrigerator compartment as stated, whereas the interface unit is positioned outside this compartment to prevent it suffering any problems connected with the low temperature, moisture and condensate present within the compartment. This constructional choice implies the use of electrical connection cables (generally of coaxial type) for connecting the sensor to said unit.

However the presence of said cables gives rise to problems of both a constructional character and a purely electrical character. In this respect, in the cables the signals emitted by the frost sensor can be distorted or modified by spurious signals or by interference arising within the cables. In such a case the handling of these signals becomes problematic and reliable refrigerator operation is not assured.

An object of the present invention is to provide a device which overcomes the drawbacks of analogous known devices. A particular object of the invention is to provide a device which is easy to construct and mount within a refrigerator, and which allows reliable control of the evaporator defrosting.

These and further objects which will be apparent to the expert of the art are attained by a device in accordance with the accompanying claims.

The present invention will be more apparent from the accompanying drawing, which is provided by way of non-limiting example and in which:

Figure 1 is a longitudinal section through a part of the refrigerator in which the device of the invention is mounted;

Figure 2 is a front view of the device according to the invention; and

Figure 3 is a front view of part of the device according to the invention.

With reference to said figures a refrigerator comprises a known evaporator 1 mounted, in the example shown in the figures, in correspondence with a wall 2 of a refrigerator compartment 3. The device 6 according to the invention is positioned on one side 5 of said wall 2 and comprises a frost sensor 7 of capacitive type directly associated with an interface unit 8 connected by an electric cable 9 to a control unit (of known type, not shown) at least able to defrost the evaporator when an excessive frost presence is detected on it by the sensor 7. The unit 8 converts the electrical signals from the sensor 7 into signals acceptable by the control unit (for example into logic signals). This unit is specifically arranged to polarize the sensor 7 so as to determine its capacitance change and make this acceptable by the unit controlling the defrosting of the evaporator 1.

The sensor 7 and unit 8 are associated with a support 10 of flexible material. This support is preferably of plastics material and can advantageously consist for example of a material known commercially as KAPTON or other materials such as that known as MYLAR. This sensor and the unit 8 are associated with the flexible support by known methods for forming printed circuits.

Specifically, the capacitive sensor 7 comprises a plurality of mutually facing flexible plates deposited on the support 10, which is positioned on a flexible insulating plate 14 connected to earth. The plates 12 and 13 are connected directly to the interface unit 8 supported by a layer of flexible material which can also be the continuation of that carrying the sensor 7 or can be a layer physically different from the layer 10 and formed of a material the same as or different from this latter.

As stated, the device obtained in this manner is associated with the wall 2 of the refrigerator compartment 3, this being achieved by known means, such as a known biadhesive layer 20 of high thermal conductivity.

Alternatively the device can be directly embedded into the wall 2 or by placed in another position in the refrigerator such as to cooperate directly or indirectly with the evaporator, depending on the type of this latter.

If it is positioned on the wall 2 it has to be suitably protected because the device is subjected to the moisture and ice present in said compartment. This protection must also protect against the abrasive effect exerted on said device during the cleaning of said wall by the user.

For this purpose, ie to provide the device 6 with the necessary protection, the sensor is coated with a layer of known adhesive film 21, for example of polyurethane or the like. Likewise the unit 8 is embedded in a layer of epoxy resin 23 (or similar material) and, advantageously, protected by a plastics box structure 24 fixed to the wall 2 of the compartment 3 in any known manner, for example mechanically by screws (not shown).

The invention provides a very compact device, formed from the sensor 7 and the unit 8, which is simple to mount in a refrigerator and is suitably protected against user cleaning and against environmental agents such as the moisture, condensate, water and temperature change produced by the defrosting and cooling.

Claims

1. A device (6) for sensing frost on a refrigerator evaporator (1), comprising at least one frost sensor (7), preferably of capacitive type, and an interface unit (8) arranged to polarize the sensor (7) so as to determine its capacitance change and make this acceptable by a unit for controlling the defrosting of the evaporator (1), characterised in that said frost sensor (7) and said interface unit (8) are associated with a flexible support (10) and are directly connected together.

2. A device as claimed in claim 1, characterised in that the flexible support is of plastics material.

3. A device as claimed in claim 1, characterised by being located in a position such as to operationally cooperate with the evaporator (1), ie in a position such as to enable the frost layer present on said evaporator to be measured.

4. A device as claimed in claim 3, characterised by being fixed to a wall (2) of an internal compartment of the refrigerator by biadhesive tape (20) of high thermal conductivity.

5. A device as claimed in claim 3, characterised by being embedded in the wall (2) of a refrigerator internal compartment (3) in proximity to which the evaporator (1) is present.

6. A device as claimed in claim 1, characterised in that the flexible support (10) is in one piece.

7. A device as claimed in claim 1, characterised in that the flexible support (10) is in two parts, one supporting the frost sensor (7) and the other supporting the interface unit (8).

8. A device as claimed in claim 1, characterised by comprising protection members (21, 23, 24) positioned in correspondence with the frost sensor (7) and interface unit (8) and arranged to protect these latter against environmental agents such as moisture, water, ice and temperature changes, and against the abrasive action exerted by the user during the cleaning of the refrigerator.

9. A device as claimed in claim 8, characterised in that the interface unit (8) is embedded in epoxy resin (23) and is advantageously covered by a rigid body (24) fixed in known manner to the wall (2) of the refrigerator compartment (3), the frost sensor (7) being coated with an adhesive film, for example of polyurethane, polyethylene or a similar plastics material.

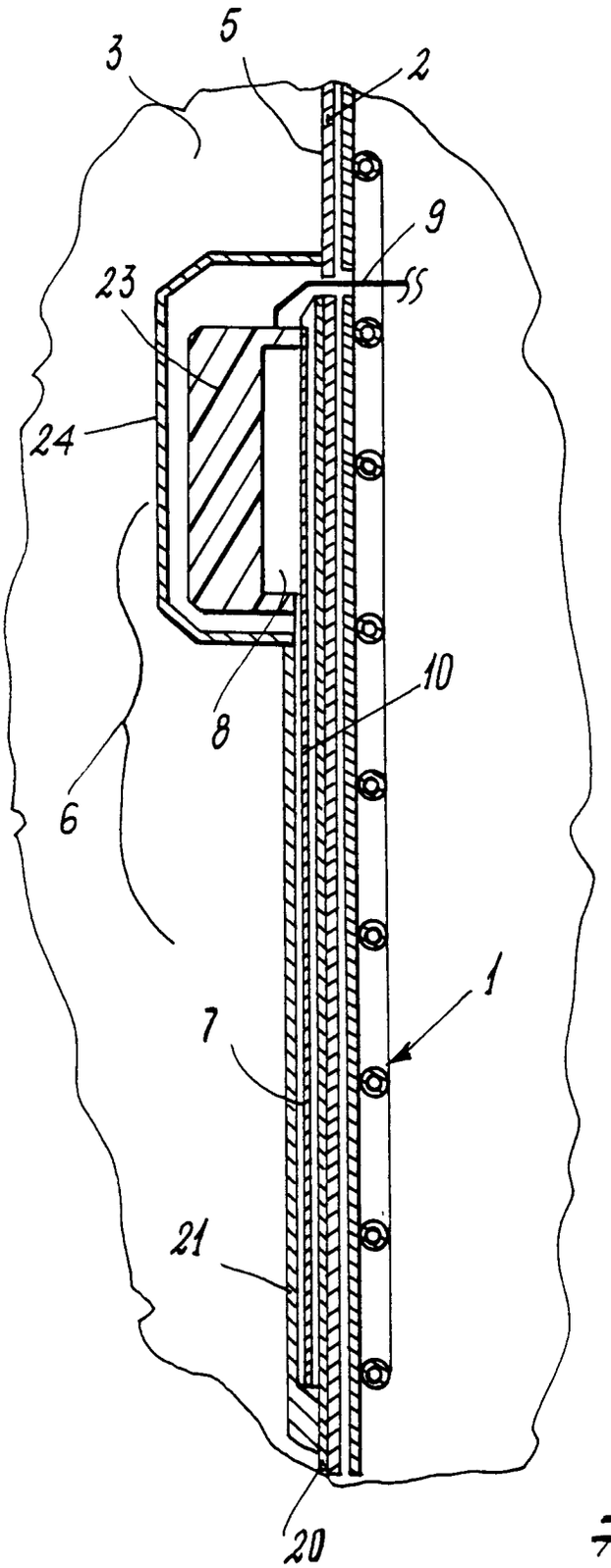

Fig. 1

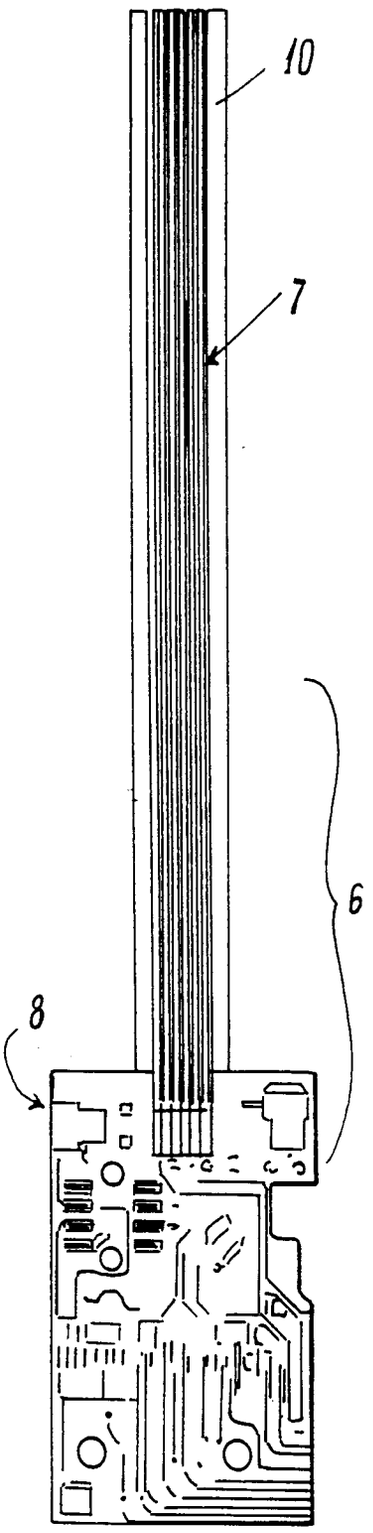

Fig. 2

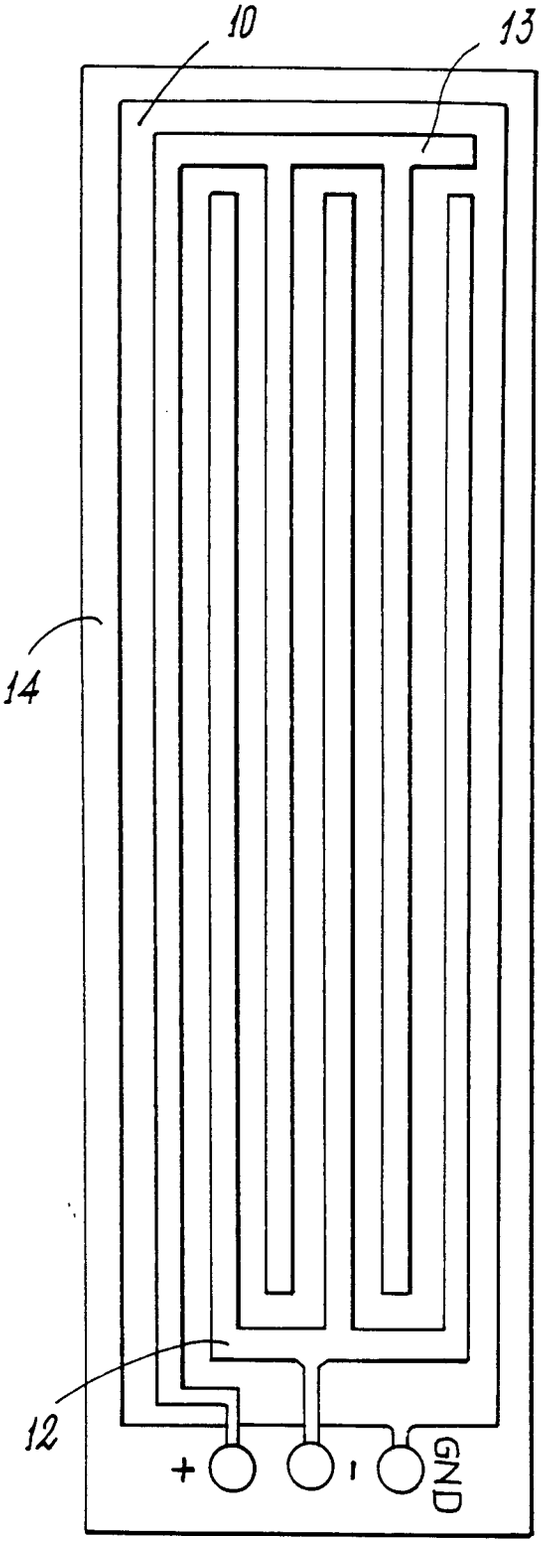

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 8082

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US-A-4 347 709 (WU M T ET AL) 7 September 1982 * column 1, line 63 - column 2, line 43; figures 1-3 *	1-3	F25D21/02
Y	WO-A-94 20819 (INNOVATIVE DYNAMICS INC) 15 September 1994 * page 3, line 17 - page 7, line 23 * * page 17, line 12 - page 18, line 3; figures 4A-4D * * page 14, line 22 - page 15, line 4; figure 2B * * page 27, line 16 - line 31; figure 9 *	1-3	
A	EP-A-0 310 101 (MURATA MANUFACTURING CO) 5 April 1989 * column 3, line 20 - column 4, line 51; figures * * column 8, line 34 - column 9, line 32 *	1,8,9	
A	EP-A-0 563 751 (WHIRLPOOL EUROP) 6 October 1993 * column 3, line 21 - column 4, line 46; figures 1-6 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F25D G01K B64D
A	EP-A-0 203 669 (PHILIPS NV) 3 December 1986 * column 3, line 39 - column 4, line 43 *	1,4,5	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 April 1995	Eccetto, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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