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**I-33170 Pordenone (IT)**(54) **Refrigeration apparatus with explosion-proof switch.**

(57) Refrigeration apparatus comprising one or more refrigerating circuits containing inflammable gases and consisting of at least a compressor, a condenser, one or more evaporators associated to at least a food storage compartment, said compartment accommodating at least an electrical switch that is accessible by the atmosphere of said compartment, wherein the electrical contacts of said switch are enclosed in an air-tight enclosure (6), said switch consisting of at least a pair of ferromagnetic metal blades (1, 2) enclosed in said enclosure (6) and adapted to establish a contact with and separate from each other.

Externally with respect to said enclosure (6) there is arranged a moving member (8) which is constrained into moving into definite positions by an appropriate guiding provision (9) and is associated with a magnetic element (7) adapted to act on the mutual position of said blades which move into a contact position or a separation position according to the position of said moving member.

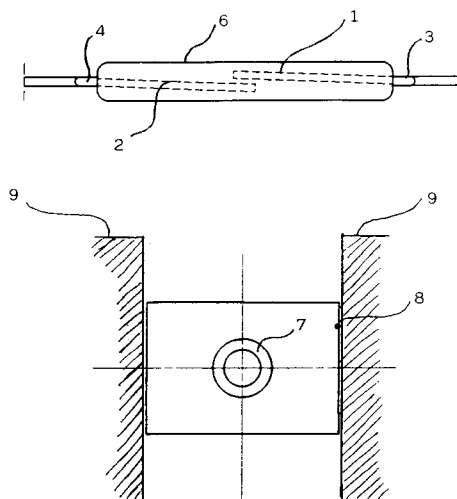


FIG. 1

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The present invention refers to an improved type of refrigeration apparatus provided with at least a food storage compartment and a plurality of electric switches that are accessible by the atmosphere of said food storage compartment, wherein said switches are appropriately isolated so as to prevent possible sparks generated by their contacts from spreading into the atmosphere of the food storage compartment.

The present invention refers to all types of refrigeration apparatuses, particularly those intended for household use, which comprise a refrigerating circuit, of which a portion, typically the evaporator, is at least partly housed inside said food storage compartment and is filled with an inflammable gas, such as for instance methane or butane.

For reasons of greater simplicity, the following description will refer to a freezing apparatus with a single food storage compartment, but it will be appreciated that the invention extends to also cover refrigeration apparatuses that may be provided with several food storage compartments and related evaporators and switches.

It is a largely known fact that the pressure exerted by the public opinion in favour of increasingly environment-friendly products, ie. products that must be environmentally sustainable even after they are discarded at the end of their life cycle, has had both directly and indirectly an impact on industry as a whole, inducing it to develop products that are capable of meeting such environment-oriented requirements to an ever greater extent. In this connection, a direct impact is unfolding through a clear trend which is discernible among consumers in general, who seem to increasingly favour so-called "ecological" or green products, putting environment-friendliness on top of their purchase criteria, as stimulated by press and advertising campaigns that are quite often made on purpose, ie. for reasons of self-interest. On the other hand, an indirect impact is being produced by the setting up and the imposition of a whole set of regulatory, manufacturing and product design obligations aiming at gradually marginalizing products that are not considered or perceived as being adequately ecological.

It is basically for this second reason that all types of refrigeration apparatuses making use of chlorofluorocarbons (CFCs) as blowing agents in their thermal insulation foams have been phased out, or are now being phased out, from production by the manufacturers in the most advanced countries of this world, while the public opinion is clearly showing a general sensitiveness for and interest in the purchase of refrigerators that do not contain chlorofluorocarbons at all, ie. not even as working fluids in the refrigeration circuit.

As a consequence, refrigeration appliances have been developed in which the refrigerant or working fluid is made up by a gas or a mixture of gases that do not feature any significant ozone-depletion potential, but are in many cases inflammable.

In order to avoid any risk of explosion in the case of such gases leaking into the closed compartment containing the stored food, particular configurations have been proposed for the internal lighting lamps, which, even if broken, do not trigger an ignition of a gas mixture that could possibly be around there.

In this connection, reference should be made to the Italian application for a utility model no. PN93U000024, filed by the same applicant, to which reference is made for the sake of brevity even in connection with all other general considerations concerning products of this kind.

It has been however observed that, even if such lamps are effectively protected against the risk of their breakage turning them into a cause of ignition of a possible inflammable gas mixture, this would at least partly prove useless if inside the food storage compartment, which may possibly be saturated with inflammable gas, there is a persisting risk of electric contacts being capable of generating sparks that would trigger the ignition and, hence, the explosion of such an inflammable gas.

In particular, since the electric contacts within said food storage compartment may be represented by the contacts of circuits being provided there for different operational and control purposes, such as for instance the contacts of the on/off switch provided for the internal lighting or still other circuits, the need arises to devise some contrivance that is effective in preventing any of such contacts of possible electric switches provided inside the food storage compartment and capable of generating sparks, from getting directly in touch with the atmosphere of said food storage compartment.

It would therefore be desirable, and it is actually a main purpose of the present invention, to provide a refrigeration apparatus, such as in particular a household refrigerator or freezer, comprising at least a food storage compartment and a plurality of electric switches, such as for instance the switch provided to automatically switch on the internal lighting of the food storage compartment when the door thereof is opened or the switch provided to start the defrosting cycle, which are arranged inside said food storage compartment, wherein said electric switches are protected against the risk of turning into an element capable of firing an inflammable atmosphere that may be present in said food storage compartment.

According to the present invention, such an aim is achieved with a particular type of switch and

arrangement for the actuation thereof, both of them being described hereinafter by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a cross-sectional view showing schematically a switch according to the present invention, as illustrated in its open-circuit condition;
- Figure 2 is a cross-sectional view of the same switch, as illustrated in its closed-circuit condition;
- Figures 3 and 4 are views illustrating two typical applications of a switch according to the present invention as shown in two different forms of presentation.

The present invention resides substantially in the utilization of a type of contact consisting of two ferromagnetic metal blades 1, 2 that are connected to respective electric conductors and restrainedly arranged in correspondence of their respective fixed end portions 3, 4 so that, when appropriately actuated by an external force, they are capable of bending until they come into contact with each other at a given point 5.

Said blades are enclosed in a casing 6 made of a non-ferromagnetic material, in particular glass, which is given an air-tight construction in such a way that said blades are completely enclosed in said casing, as this is shown in Figures 1 and 2.

Outside said casing there is provided a magnetic element 7, which is enclosed in a sheath 8 and is usually in the shape of a lever or a push-button. The actuation arrangement, as made up by said magnetic element and the sheath 8, is restrained in its movement by a guide 9 which is adapted to allow such an actuation arrangement to be displaced in such a way as to be able to modify its magnetizing action on said blades to such an extent as to force them into coming into contact with each other or separating from each other, depending on the position in which said actuation arrangement is set.

It is now fully apparent that an electric switch is in this way provided that is fully and inherently safe as far as the problem is concerned of a possible firing of an inflammable atmosphere building up around it, since the above cited contact 5 between and the subsequent separation of said two blades 1, 2 occur in all cases inside said casing 6 which, owing to its sealed and air-tight construction, positively prevents the surrounding atmosphere from being able to touch said point of contact, where sparking could therefore occur.

As far as the movement of said blades is concerned, this is actuated by the simple displacement of a magnetic element which is pushed through the sheath in which it is encapsulated or anyway constrainedly confined, and which cannot

therefore prove dangerous at all in connection with a possible firing of an inflammable gas mixture, while at the same time ensuring a most reliable operation and an overall cost-effectiveness of its construction through the utilization of readily available, simple and reliable techniques.

A particularly advantageous embodiment of the present invention is illustrated in Figures 3 and 4, which show a cut-away view of the component parts of a switch, as depicted individually, and the same component parts as assembled in a preferred installation within a lamp-holding fixture, respectively.

Said switch can be seen as being constituted by a push-button 11 provided for actuation by the door of the appliance and connected to a rod 12, at the opposite end 13 of which there is provided a member 14 adapted to accommodate the magnetic element 16 in a recess 15 thereof, said magnetic element being arranged displaceably within said recess and being held in its position there by an appropriate spring means 17 which is in turn held in place by a retaining means 18.

The actuation into a lengthwise displacement of said rod 12 causes the associated magnetic element 16 to be in turn displaced with respect to the switch 19 (see Figure 4) and, as a result, said switch to be actuated accordingly.

It will be appreciated that the switch can be provided even for purposes and applications, as well as in forms differing from the ones that have been illustrated here, without departing from the scope of the present invention.

### Claims

1. Refrigeration apparatus, in particular a household-type refrigerator or freezer, comprising one or more refrigerating circuits containing inflammable gases and consisting of at least a compressor, a condenser, one or more evaporators associated to at least a food storage compartment, said food storage compartment containing at least an electric switch accessible by the atmosphere of said food storage compartment, **characterized in that** the electric contacts of said switch are enclosed within an air-tight enclosure (6).
2. Refrigeration apparatus according to claim 1, **characterized in that** said switch comprises at least a pair of ferromagnetic metal blades (1, 2) enclosed in said air-tight enclosure (6) and arranged to move into contact with each other and separate from each other.
3. Refrigeration apparatus according to claim 2, **characterized in that** on the outer side of

said enclosure (6) there is provided a moving member (8) which is constrained into moving into definite positions by appropriate guiding means (9), said moving member being associated with a magnetic element (7) adapted to act on the mutual position of said blades, said blades being further adapted to move into a contact position or a separation position depending on the position of said moving member.

4. Refrigeration apparatus according to any of the preceding claims, **characterized in that** said moving member (8) is the sensing element (9) provided to detect whether the door of said food storage compartment is open or closed, and that said switch is adapted to open or close the contacts to cut or establish the power supply to the lamp provided for the internal lighting of said food storage compartment.
5. Refrigeration apparatus according to any of the preceding claims from 1 to 4, **characterized in that** said moving member is associated with the mechanical actuation means provided to start the defrosting cycle in the food storage compartment, said switch being adapted to open or close the contacts to cut or establish the power supply to the defrost heating element.

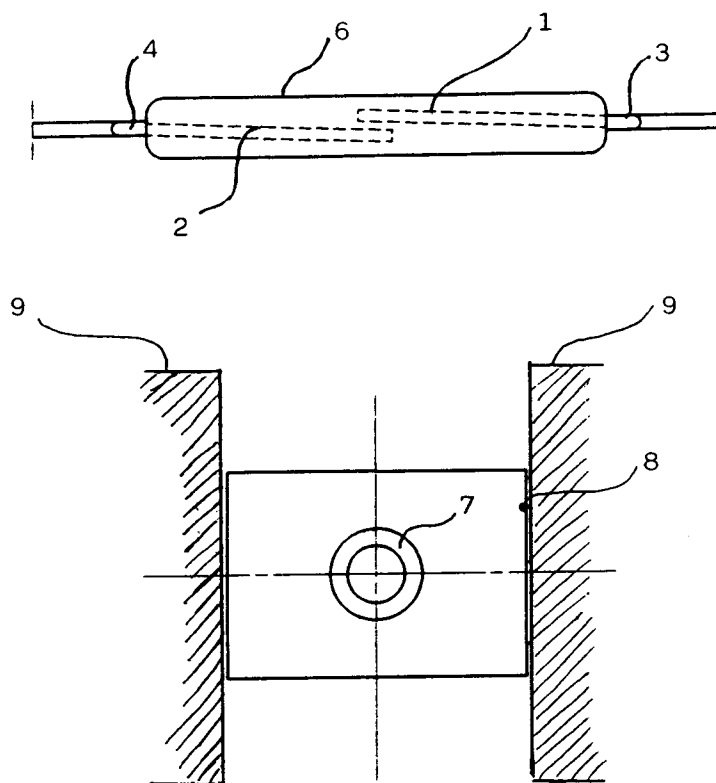


FIG. 1

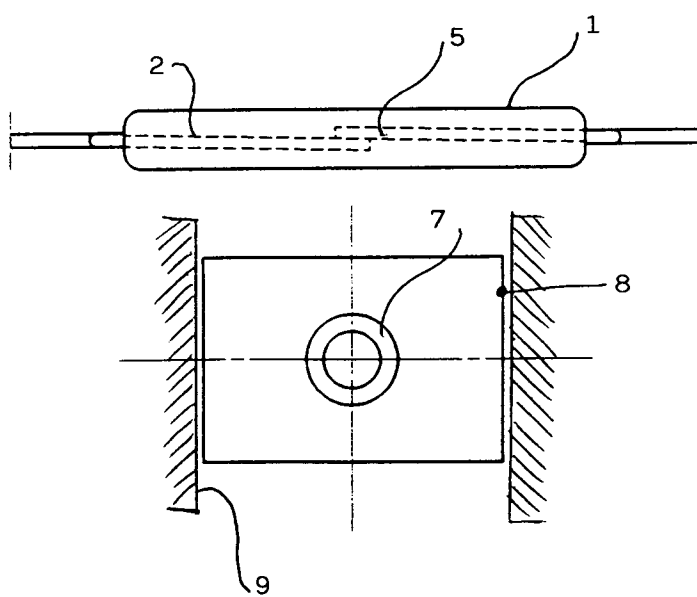


FIG. 2

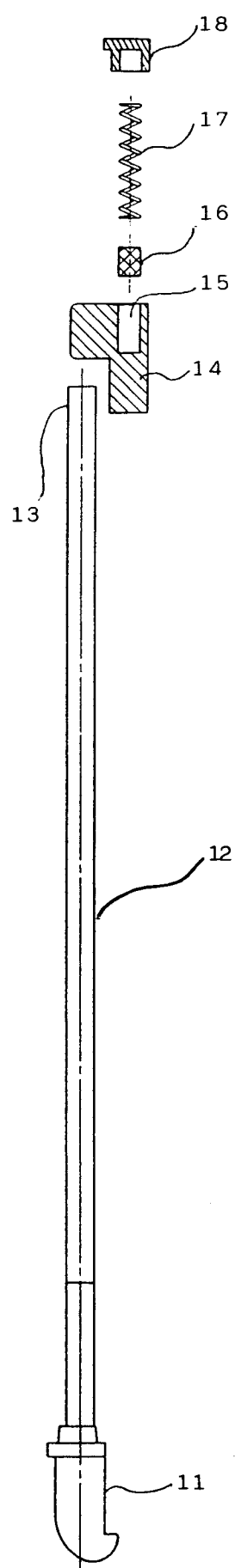
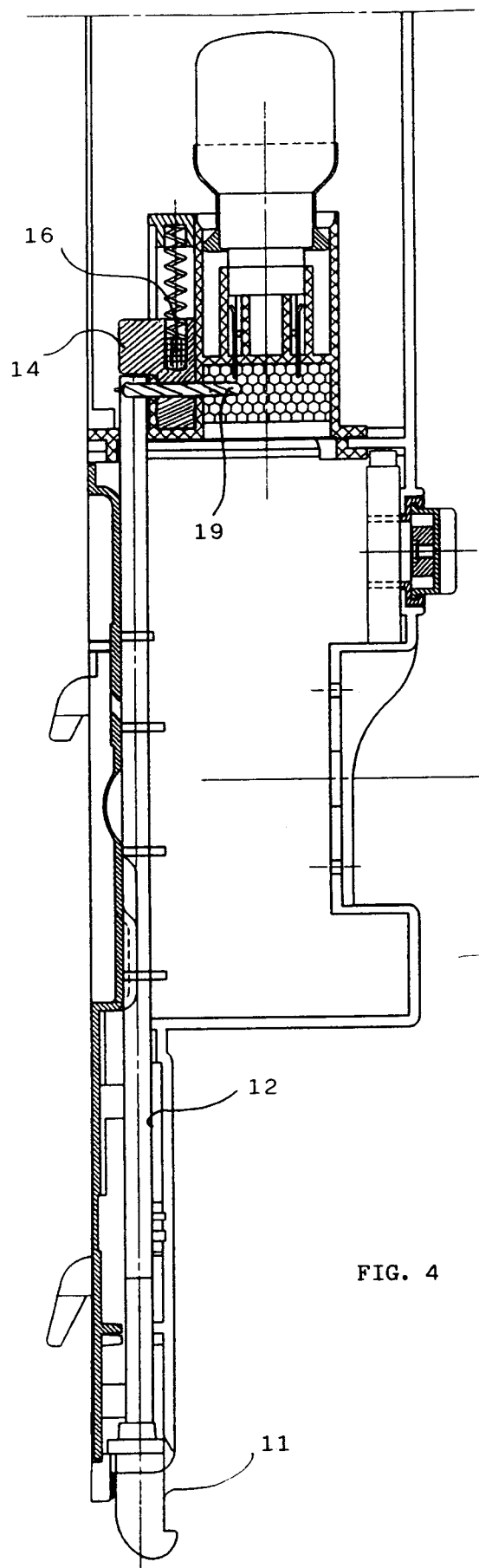


FIG. 3





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# EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 95105706.6
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 6)
X	<u>CH - A - 675 628</u> (H. FORSTER AG) * Totality *	1, 2	F 25 D 29/00 H 01 H 1/66 H 01 H 36/00
A	--	3, 4	
Y	<u>DE - A - 2 905 598</u> (BÄR ELEKTROWERKE KG) * Fig. 4 *	1-4	
Y	-- <u>US - A - 3 974 469</u> (NICHOLLS) * Fig. 5; abstract *	1-4	
A	-- <u>DE - A - 2 644 177</u> (SIEMENS) * Totality * ----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 6)
			F 25 D H 01 H
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 01-09-1995	Examiner WITTMANN
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			