The present invention relates to plastic foam insulated cabinets such as refrigerator cabinets comprising a wall structure including inner and outer panels separated by a layer of plastic or resin foam insulation. It has particular reference to refrigerators having an electrically energized element, such as a getter conditioner, a light or the like, mounted on one of the panels and an improved electrical lead arrangement passing from the element through the space between the inner and outer panels to a source of electric power.

It is common practice in the case of household refrigerators to provide within the cabinet storage compartment one or more electrically energized elements, such as an illuminating device or an electrically heated butter conditioner. As these elements are mounted on the interior wall portions of the cabinet, the electrical conductors or leads connecting these elements to an external source of power must pass through the insulated space between the inner and outer panels. Failure of the insulation on the electrical leads with possible arcing between the bare leads presents no fire hazard problem in cabinets in which the space between the inner and outer panels is filled with glass wool, rock wool, or equivalent non-combustible, electrically insulating materials. However, as a result of the development of improved plastic foams, such resinsous materials, because of their better insulating properties, appear to be gradually replacing glass wool and the like as refrigerator insulation. While the presently available foam materials of this type are stable at both normal and somewhat elevated temperature conditions, because of their organic nature they will support combustion when heated to a sufficiently high temperature as for example to the temperature of an electric arc.

It is the primary object of the present invention to provide in a resin foamed cabinet structure an improved electrical conductor arrangement designed to prevent a fire hazard in the event of a failure of the insulation on the electrical conductors.

Another object of the invention is to provide a cabinet structure including spaced inner and outer panels, foam insulation between the panels and an improved electric conductor arrangement designed, in the event of an electrical insulation failure, to prevent sparking or arcing between the conductors.

A further object of the invention is to provide a cabinet structure including inner and outer panels, a layer of foam insulation between the panels and a pair of electric leads so arranged within the space between the inner and outer panels that electrical failure at any point along the lengths of the leads within the structure will not cause ignition of the resinous foam.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention reference may be had to the accompanying drawing in which:

FIG. 1 is a front elevation of a refrigerator cabinet embodying the present invention;
FIG. 2 is an enlarged elevation of a portion of the cabinet of FIG. 1;
FIG. 3 is a sectional view taken along line 3—3 of FIG. 1; and
FIG. 4 is a sectional view taken along line 4—4 of FIG. 1.

While the present invention is applicable to any cabinet structure including inner and outer spaced panels, resinous foam insulation therebetween and electrical conductors disposed within the space between the inner and outer panels in proximity to the resin foam layer, it will be particularly described with reference to refrigerator cabinet and more specifically to the door component of a refrigerator cabinet structure comprising a butter conditioner compartment and an electric heater for maintaining that compartment at a temperature somewhat above the normal temperature prevailing within the refrigerator cabinet.

Referring now to FIG. 1 of the drawing there is shown, by way of example, a household refrigerator cabinet 1 having a door 2 mounted on the front portion of the cabinet for the purpose of providing access to the interior or food storage space within the cabinet. This door is mounted by means of an upper hinge 3 and a lower hinge 4. The door comprises an outer panel 5 of sheet metal or the like and an inner panel 6 which is normally composed of a sheet plastic material and is formed to include a butter storage and conditioning compartment 7.

The space between the outer panel 5 and the inner panel 6 is substantially filled with a resinous foam insulation 8 such as a polyurethane foam.

To facilitate the manufacture of a door of this type, the polyurethane foam 8 is preferably formed in situ in contact with the outer metal panel 5 while the inner panel 6 is formed in a mold having a shape or configuration such that the inner surface 9 of the foam layer will conform substantially to the shape or contour of the inner panel 6. After formation of the foam layer 8 the inner panel 6 is suitably secured to the outer panel 5 by means of a series of screws or other fastening means 10.

In order to connect the heater 11 used to warm the butter conditioner 7 to a source of electrical energy, there is provided a pair of conductors 14 connected at one end to the heater 11 and extending between the surface 9 of the foam layer and the inner panel 6 to and through the hinge pin 15 which, as shown in FIG. 3, includes a hollow hinge pin 15 whereby the electrical conductors 14 can be led outwardly through the hinge structure and finally to the machine compartment (not shown) of the refrigerator for connection to the same electrical supply lines employed to energize the refrigerator compressor.

As previously indicated the polyurethane foams and other resinous foam materials suitable for use as refrigerator insulation are inflammable at elevated temperatures such as those produced by an electric arc. Accordingly, an electrical failure resulting from defective or overheated electric insulation on the conductors 14 may present a fire hazard wherever the conductors 14 are in contact with the foam insulation at a point where there is sufficient air to support combustion once the foam is ignited.

In order to prevent this fire hazard in accordance with the present invention, there is provided an improved lead-in conductor arrangement. More specifically there is provided a combination metal sheath and spacing means 17 designed to enclose the lengths of the conductors 14 extending through the space 18 between the surface of the foam 9 and the inner panel 6. This sheath, in addition to maintaining the insulated conductors 14 out of direct contact with the foam 8, is also designed to maintain the conductors 14 in spaced relationship and at a distance greater than the normal arc gap. In other words, the conductors 14 are maintained by the sheath 17 in spaced relationship a distance greater than that which...
will be bridged by an arc between the conductors in the event of an insulation failure.

In the illustrated modification of the invention, the sheath 17 is preferably composed of a thin metal foil such as aluminum foil having its opposite edges 20 folded over the spaced conductors 14 into either abutting or overlapping relationship. The center portion of the sheath including the folded edge portions 20 of the foil is then stitched together so that the stitches 22 secure the opposed face portions of the sheath together between the conductors 14 in order to maintain the conductors 14 in spaced-apart relationship.

The sheath 17 is provided on all portions of the conductors 14 disposed within the air space 18 between the foam and inner panel 6. In addition to maintaining the conductors spaced a distance greater than their arcing distance and of dissipating over a larger area any heat resulting from any abnormal current conditions under which the insulation does not melt but does become overly warm, the sheath also provides a conducting path between the conductors to prevent any sparking as a result of electrical failure of the insulation on the conductors. The sheath 17 accomplishes this result by providing a short circuiting path between the conductors in the case of an electrical insulation failure which is in the nature of a dead short so that the fuse or circuit breaker normally provided for protecting the refrigerator circuit will open before abnormal igniting temperatures result in the fault area. In other words, while the sheath 17 maintains the wires spaced beyond their normal sparking distance, in the event of conductor insulation failure, it also prevents any arcing or sparking between the wires in the event of an electrical insulation failure by forming a direct electrical connection between the wires in the form of a dead short. As a result, the temperatures at the insulation fault area are kept substantially below those which may cause ignition of the foam insulation.

In order to complete the protection of the electrical leads 14, the opposite ends of the sheath 17 are terminated in an environment which will not support combustion in the event of insulation failure at or adjacent the ends of the sheath 17. In the illustrated embodiment of the invention, the one end 23 of the sheath 17 terminates within the foam layer 18, or in other words, out of contact with the ambient atmosphere. In the absence of air or other combustion supporting gas in this area, failure of the electrical insulation on the portions 24 of the conductors 14 embedded in the foam 8 will merely melt the adjacent portions of the foam 8 even though some arcing may occur. If the melted foam does not itself then provide the necessary insulation between the adjacent conductors 14, the fuse or other protective device in the supply circuit will open.

The other end of the sheath 17 as illustrated in FIG. 2 of the drawing is terminated in a layer of glass wool or other fibrous inorganic material 25 surrounding the butter conditioner compartment 7 and enclosing the heater 11 provided for warming this compartment. Conductor insulation failure in this area will present no more of a problem than in the case of the usual rock or glass wool insulated cabinets since the failure area will be separated from the adjacent foam 8 by the inorganic insulation 25.

While there has been shown and described a particular embodiment of the present invention, it is to be understood that the invention is not limited thereto and that it is intended by the appended claims to cover all modifications within the spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An insulating wall structure comprising inner and outer panels, a layer of plastic foam between said panels and spaced from one of said panels, an electrically energized element mounted on said one panel, a layer of fibrous inorganic insulating material enclosing said element, a pair of insulated electrical conductors having portions thereof disposed in the space between said foam layer and said one panel, said conductors having their one ends connected to said element and their other ends extending into said foam layer, and means for preventing ignition of said plastic foam upon failure of the insulation on said conductor comprising a metal sheath enclosing said conductors and formed to maintain the portions of said conductors within said space in spaced relation, the opposite ends of said sheath respectively terminating within said layer of fibrous inorganic insulating material and within said layer of plastic foam.

2. An insulating wall structure comprising inner and outer panels, a layer of plastic foam between said panels and spaced from one of said panels, an electrically energized element mounted on said one panel, a layer of fibrous inorganic insulating material enclosing said element, a pair of insulated electrical conductors extending from within said layer of plastic foam through the space between said foam layer and said one panel and into said layer of fibrous inorganic insulating material, and means for preventing ignition of said plastic foam upon failure of the insulation on said conductor comprising a metal sheath enclosing said conductors and formed to maintain the portions of said conductors within said space in spaced relation, the opposite ends of said sheath respectively terminating within said layer of fibrous inorganic insulating material and within said layer of plastic foam.

References Cited in file of this patent

UNITED STATES PATENTS

2,303,806  Wild  Dec. 1, 1942
2,775,430  Norberg  Dec. 25, 1956
2,802,346  Simmons  Aug. 13, 1957
2,873,352  Franco  Feb. 10, 1959

2,802,346  Simmons  Aug. 13, 1957