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GB 0563439 US 3701282

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G1D
Selected US specifications from IPC sub-class
G01K

(54) Indicator for monitoring the temperature of chilled or frozen products

(57) A reusable indicator (6) for monitoring the temperature of chilled or deep-frozen products e.g. foodstuffs, medicines consists of one or more chambers (7, 8) arranged symmetrically about an axis of rotation (11), each chamber being at least partially filled with an indicator fluid (10, 30) the fluids freezing at different temperatures. On melting the liquid runs to the bottom of the chamber. To bring the indicator into the monitoring state, it is centrifuged about its axis (11), whereby the liquid is urged against the outer wall of its chamber and then frozen.

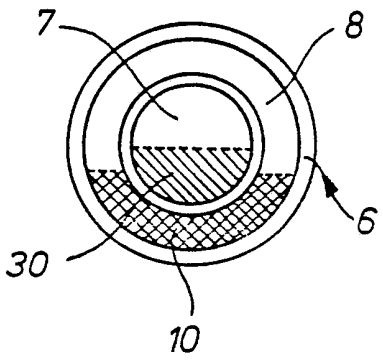

FIG 1

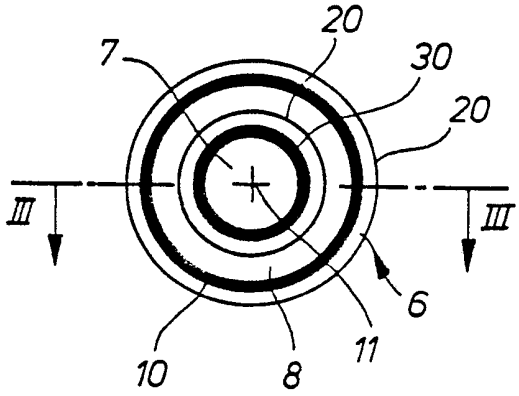

FIG 2

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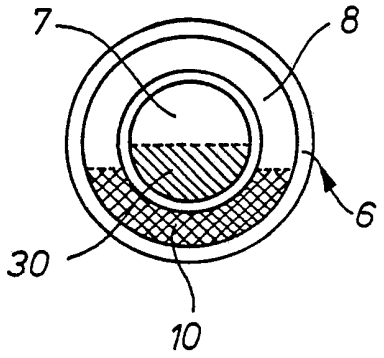

FIG 1

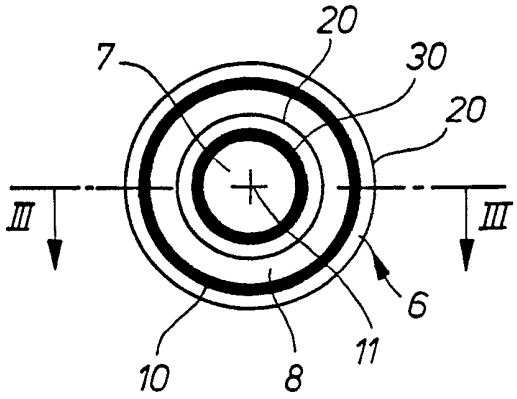

FIG 2

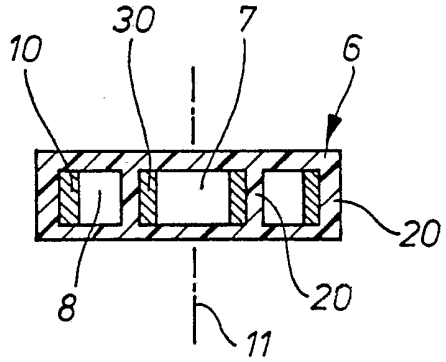

FIG 3

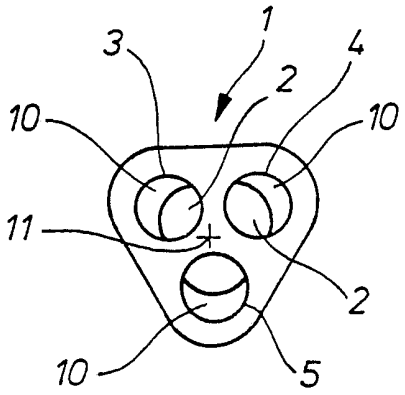

FIG 4

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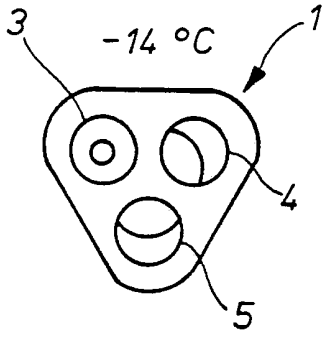

FIG 5

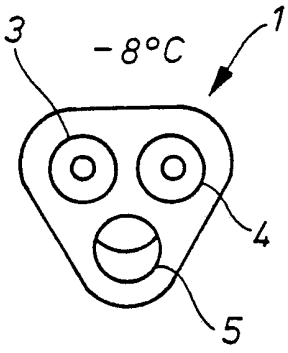

FIG 6

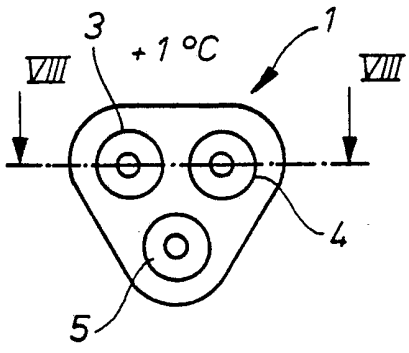

FIG 7

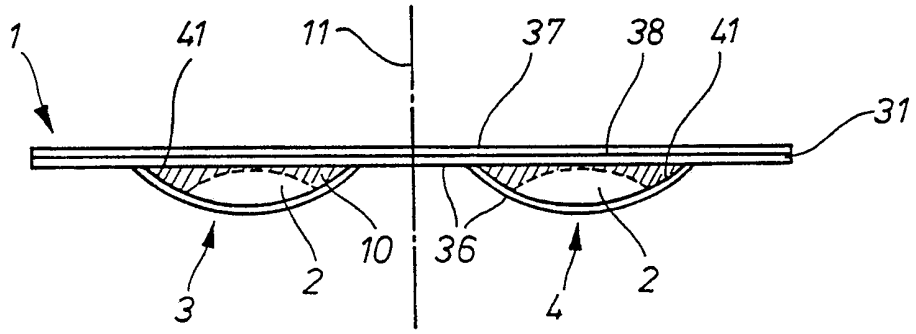

FIG 8

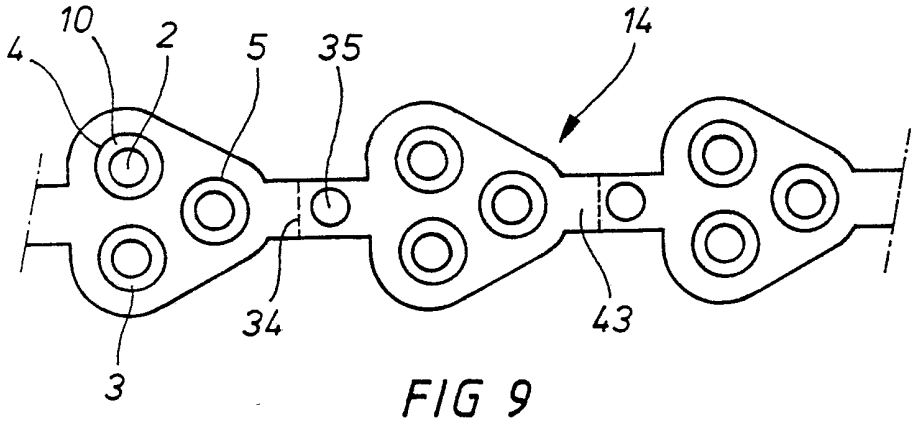

FIG 9

A METHOD OF PRODUCING AN INDICATOR FOR MONITORING THE TEMPERATURE OF A CHILLED OR DEEP-FROZEN PRODUCT, AND ALSO USE OF THIS INDICATOR

The invention relates to a method of producing an indicator for monitoring the temperature of chilled or deep-frozen products, as well as to the use of an indicator, produced in accordance with this method, and to the construction of this indicator.

A large number of indicators for monitoring the storage temperature of chilled or deep-frozen products have become known (DE-OS 25 47 638, US 4 432 656, DE 33 11 591A1).

However, inherent to the known indicators is the disadvantage that they are relatively difficult to produce, complicated to handle and, moreover, are not readily re-usable.

For example, in the case of DE 33 11 591A1 a thermally expansible fluid is used which, when below a critical temperature, bursts a capsule, whereby then the indicator is activated. Such an indicator is not re-usable and is, moreover, relatively costly to produce.

Accordingly, an object of the invention is to design an indicator of the type mentioned at the beginning hereof in such a way that a simple and economical production method is possible and the indicator produced therewith is re-usable.

From one aspect, the invention consists in a method of producing an indicator for monitoring the

temperature of chilled or deep-frozen products, such as for example foodstuffs, medicines and the like, which indicates durably the exceeding of a critical temperature, comprising the steps of:-

a) using, as a fixed geometrical shape, one or more hollow forms arranged about an axis of rotation,

b) partially filling this hollow form or hollow forms with fluid,

c) then centrifuging the hollow form or hollow forms until the fluid is disposed in the outer circular zone of the hollow form or of the hollow forms,

d) cooling the rotating hollow form or hollow forms during the centrifuging until the fluid present in the outer circular zone of the hollow form or hollow forms solidifies.

From another aspect, the invention consists in an indicator for monitoring the temperature of chilled or deep-frozen products, such as foodstuffs, medicines and the like, which indicates durably the exceeding of a critical temperature, wherein the indicator has one or more hollow forms which are separated from one another and each hollow form is filled at least partially with a freezable fluid.

With the described method of production an indicator is proposed in the case of which the indicator fluid is frozen during a centrifuging process and is thus brought into its functional state for monitoring deep-chilled or chilled products.

The chambers of the indicator are, in this respect, arranged about the axis of rotation of the centrifuge and are filled with freezable fluids. Above

the desired critical temperature the indicator fluid is preferably fluid or semifluid. In this state the indicator is centrifuged and thus, along with simultaneous cooling or freezing during the centrifuging process, the fluid is brought into a solid or semi-solid state. In this state the fluid, in accordance with the construction of the individual chambers of the indicator, accumulates respectively on the radial outwardly lying wall of the chamber and solidifies there.

The indicator has thus achieved its functional state (monitoring state) and can now be used, as intended, for monitoring one or more critical temperatures. Associated with each critical temperature that is to be monitored is, in this respect, a chamber having a fluid which melts specifically at this critical temperature. Preferred as possible fluids are in particular alcohol/water mixtures or alcohol/water/glycol mixtures. Thus, in accordance with the composition of the indicator fluid, substances with a critical temperature below 0°C can be monitored, equally also products or substances having a critical temperature above 0°C can be monitored. Preferably mixtures of 80% water and formic or acetic acid are used as indicator fluid for the monitoring of chilled products and substances above a temperature of 0°C. Therewith for example a critical temperature of +8°C can be monitored, because the indicator fluid freezes at this temperature during the centrifuging process and assumes a solid form on the radial outwardly lying chamber wall of the indicator.

In order to make the monitoring more strongly assertive, the various indicator fluids for monitoring different critical temperatures can also be coloured differently.

There are several possibilities for the design of an indicator having several chambers for monitoring different critical temperatures.

Hence, the indicator may consist of a circular-ring-shaped hollow form which is subdivided, by dividing walls arranged concentrically with the axis of rotation, into circular-ring-shaped cavities which are separated from one another, in which respect each cavity is filled at least partially with the freezable fluid.

In another embodiment the indicator may be designed substantially as a disc-shaped carrier in which one or more chambers separated from one another in radial distance from the axis of rotation are arranged, in which respect each chamber contains a different freezable fluid.

With the described indicators and with the method of production in accordance with the invention it is possible even for a housewife to use for satisfactory monitoring of the cooling conditions of foodstuffs frozen by her. A small motor-driven centrifuge is merely required, which is inserted with the not yet frozen indicators into the deep-freezing chest until they are frozen and can be affixed in a heat-conducting manner to the goods to be cooled.

For simple use it is recommended, in accordance with the invention, to provide a packaging for the

indicators which on the one hand precludes impairment of the foodstuffs, on the other hand for example by transparency ensures simple monitoring.

The inventive object of the present invention emerges not only from the object of the individual patent claims, but also from the combination of the individual patent claims one with another. All the details and features, disclosed in the documents - including the abstract - particularly the spatial design shown in the drawings are claimed as material to the invention, insofar as they are individually or in combination new compared with the prior art.

The invention will be explained in more detail hereinbelow with reference to drawings which show several ways of implementation. In this respect, further features and advantages of the invention will become apparent from the drawings and their description.

Figure 1 shows a plan view of an indicator in a first embodiment with molten indicator fluids;

Figure 2 shows the same representation as Figure 1 with frozen indicator fluids after the centrifuging;

Figure 3 shows a section in accordance with the line III-III in Figure 2;

Figure 4 shows a plan view of a further embodiment of an indicator (monitoring state) with frozen indicator fluids;

Figure 5 shows a representation as in Figure 4, in which respect the indicator fluid in one chamber is molten;

Figure 6 shows the same representation as Figure

4, in which respect the indicator fluid in two chambers is molten;

Figure 7 shows the same representation as Figure 4, in which respect the indicator fluid in three chambers is molten;

Figure 8 shows a section through the indicator in accordance with Figure 7 along the line VIII-VIII in Figure 7;

Figure 9 shows a plan view of indicators in accordance with Figure 4 connected together in a belt-shaped manner.

The indicator 6 in accordance with Figures 1 to 3 consists of a cylindrical hollow form in which, through a circular-cylindrical dividing wall 20, two circular-ring-shaped cavities 7,8 which are separated from one another in a fluid-tight manner are arranged. Each cavity 7,8 is filled at least partially with a fluid 10,30, in which respect the two fluids 10,30 have different freezing temperatures.

For example, the fluid 30 arranged in the inner cavity 7 melts at a temperature of -5°C, whilst the fluid 10 arranged in the outer cavity 8 melts at a temperature of -15°C.

Figure 1 shows the indicator 6 in its alarm state, i.e. the indicator has been warmed to a temperature of more than -5°C (e.g. 0°C), wherewith both fluids 10,30 in the cavities 7,8 are molten and assume the position shown in Figure 1.

An observer can now readily observe, through the preferably transparent walls of the indicator 6, the state of the fluids 10,30.

In order to bring such an indicator 6 into its functional state for monitoring two different critical temperatures, it is placed onto a centrifuge, not shown in more detail, connected to the centrifuge head and centrifuged about the axis of rotation 11, whereby the fluids 10,30 settle in the form of circular rings in accordance with Figure 2 on the radial outwardly lying inner sides of the dividing walls 20 of the indicator 6.

During the centrifuging process the centrifuge is placed for example into the freezer chest or the refrigerator, in which respect the fluids 10,30 solidify when the temperature in the refrigerator or the freezer chest lies below the lowest critical temperature that is to be monitored.

It is important that, through the use of a centrifuge, the indicator 6 can be brought out of its alarm state in acccrdance with Figure 1 at any time into its functional state in accordance with Figure 2. It is thus a matter of a reversible process.

In another embodiment of the present invention an indicator 1 is proposed in which circular-ring-shaped cavities 7,8 are not - as in the embodiment in accordance with Figures 1 to 3 - provided, but in the case of this indicator 1 several chambers 3,4,5 are arranged separated from one another in a rotationally-symmetrical manner with respect to the axis of rotation 11.

Each chamber 3,4,5 forms a cavity 2 and is at least partially filled with a freezable fluid 10, in which respect the fluids 10 of the respective chambers

3,4,5 differ from one another in their composition in such a way that for example the fluid 10 in the chamber 3 serves to monitor a critical temperature of -14°C, the fluid 10 in the chamber 4 serves to monitor a critical temperature of -8°C and the fluid 10 in the chamber 5 serves to monitor a critical temperature of +1°C.

The indicated critical temperatures are, of course, merely exemplary and can be varied within wide limits depending on the nature and composition of the fluid 10 used.

The indicator 1 consists of a disc-shaped carrier 31 in accordance with Figure 8, of a plastics foil, e.g. a polyethylene or a PVC foil, into which the described chambers 3,4,5 are formed in the deep-drawing process. Upwardly the carrier 31 is covered by a transparent plastics foil 36, into which the arched parts of the chambers 3,4,5 are formed.

If, however, in a further embodiment of the present invention, a plastics/metal composite foil is used for the carrier 31, further advantageous features emerge.

If at the base side a metal foil 37 is used for the carrier 31, then a considerably higher thermal conductivity as compared with the plastics foil 36 is obtained. The indicator is then in heat-conducting contact with the deep-frozen or chilled goods by way of the metal foil 37 and thus has an excellent response behaviour.

If, for example, a ratio of the thermal conductivity of the metal foil 37 in comparison with the

thermal conductivity of the plastics foil 36 of 1 : 2 is chosen and if a further plastics foil 38 is arranged between the metal foil 37 and the plastics foil 36 forming the chambers 3 to 5, then this leads to the fact that the indicator fluid 10 standing in thermal contact with the plastics foil 38 effectively thaws only when the surface of the chilled or frozen goods also actually reaches the temperature necessary for the thawing in the indicator fluid 10.

In this way, by using a metal/plastics composite foil the heat transfer from the chilled goods in the direction of the indicator fluid can be varied within wide limits.

The indicator unit 1 shown in Figures 4 to 8 is now subjected to the same centrifuging process as has been described with reference to the embodiment of Figures 1 to 3. The indicator is thus whirled about its axis of rotation 11, and at the same time exposed to the lowest critical temperature to be monitored, whereby the indicator fluids in the chambers 3 to 5 settle in the position shown in Figure 4, on the radial outwardly lying parts of the chambers 3,5. The indicator shown in the monitoring state in Figure 4 has thus been cooled for example to a temperature of -15°C.

If, now, the indicator is brought to a temperature of, for example -14°C, then the fluid arranged in the chamber 3 melts and assumes the form shown in Figure 5, in which respect the fluid is distributed uniformly in the chamber 3 and in the centre an air bubble or a cavity forms, so that it is immediately

perceived in accordance with Figure 5 that the indicator has been exposed to a temperature of more than -14°C.

If also additionally a temperature of -8°C is exceeded, then also the indicator fluid 10 in the chamber 4 melts, and the fluids in the chambers 3,4 assume the distribution shown in Figure 6.

If the indicator is heated still further to a temperature of +1°C, then also the indicator fluid 10 arranged in the chamber 5 melts, and the fluids in the chambers 3 to 5 assume the distribution shown in Figure 7.

Figure 7 thus shows an indicator which has been warmed to a temperature of at least +1°C. Thus, with the described indicator, in accordance with the present embodiment three different temperatures can be monitored.

It is, of course, possible, by arranging several chambers 3 to 5, also to monitor more than or less than three critical temperatures.

Additionally, moreover, Figure 8 shows, in a further development of the present invention, that it can be advantageous to arrange capillary gaps 41 at the radial outwardly lying parts of the chambers 3 to 5.

In this respect it is important that the chambers 3 to 5 in their radial outwardly lying edge region are designed conically with respect to the disc-shaped carrier 31. In this way the fluid 10, upon melting, is distributed not only under the influence of gravity, but in addition to this also under

capillary action.

A distribution of the fluid under the force of gravity could be influenced by an unfavourable position of the indicator 1 and the perceptibility of the melting of the fluids 10 could therewith be impaired.

If, however, capillary gaps 41 are arranged at least on the radial outwardly lying parts of the chambers 3,5 (with respect to the axis of rotation 11), the fluid 10 is distributed, upon melting, under capillary action, i.e. it creeps also into the capillary gaps 41 of the chambers 3 to 5 - even against the force of gravity - whereby a good perceptible distribution of the fluid 10, after melting, in the entire chamber 3,5 is ensured, irrespective of the position in which the indicator 1 is exposed to heating.

Such a distribution under capillary action has the further advantage that possible fraudulent intentions are prevented, since a renewed centrifuging of the once thawed indicator unit is then no longer possible, because traces of the fluids are then at all times visible in the capillary gaps 41 of the chambers 3 to 5. This would be afforded whenever the capillary gaps 41 are not only arranged in the radial outwardly lying parts of the chambers 3 to 5 with respect to the axis of rotation 11, but also form, running circularly around, the respective transition of the respective chamber 3 to 5 to the disc-shaped carrier 31.

Upon the centrifuging, then the centrifugal force forces the fluid into the circular-ring-shaped capillary gaps 41 and upon the thawing the fluid

creeps out of the capillary gaps and is distributed annularly in the respective chamber 3 to 5.

Figure 9 shows a simple possibility of the industrial production of such indicators 1, which in accordance with the invention form a strip 14 which is formed by individual connected-together indicators 1. Each indicator 1 is connected to the neighbouring indicator by way of a bridge 43, in the region of which a predetermined breaking edge 34 is arranged.

The indicators are thus produced simply by punching out from a multiple composite foil and the chambers 3 to 5 formed out in the deep-drawing process. The indicators 1 can then easily be separated from one another by breaking off in the region of the predetermined breaking edges 34, whereby, to facilitate handling, a knob-shaped handle 35 in the region of the web 43 can be additionally associated with each indicator.

CLAIMS

1. A method of producing an indicator for monitoring the temperature of chilled or deep-frozen products, such as for example foodstuffs, medicines and the like, which indicates durably the exceeding of a critical temperature, comprising the steps of:-

a) using, as a fixed geometrical shape, one or more hollow forms arranged about an axis of rotation,

b) partially filling this hollow form or hollow forms with fluid,

c) then centrifuging the hollow form or hollow forms until the fluid is disposed in the outer circular zone of the hollow form or of the hollow forms,

d) cooling the rotating hollow form or hollow forms during the centrifuging until the fluid present in the outer circular zone of the hollow form or hollow forms solidifies.

2. An indicator for monitoring the temperature of chilled or deep-frozen products, such as foodstuffs, medicines and the like, which indicates durably the exceeding of a critical temperature, wherein the indicator has one or more hollow forms which are separated from one another and each hollow form is filled at least partially with a freezable fluid.

3. An indicator according to claim 2, wherein the indicator consists of a circular-ring-shaped hollow form (chamber) which is subdivided, by dividing walls arranged concentrically to the axis of rotation, into

circular-ring-shaped cavities which are separated from one another, and each cavity is filled at least partially with the freezable fluid.

4. An indicator according to claim 2, wherein the indicator is constructed as a disc-shaped carrier, in which one or more chambers arranged in radial distance from the axis of rotation are arranged.

5. An indicator according to claim 2, 3 or 4, wherein the freezable fluids are differently coloured and have different melting temperatures of, for example, -14°C, -8°C and +1°C.

6. An indicator according to claim 3, 4 or 5, wherein the cross-section of each chamber in the radial edge region remote from the axis of rotation narrows along with the formation of a capillary gap.

7. An indicator according to claim 4 and one or more of claims 5 and 6, wherein several indicators are respectively connected together one-sided on a narrow side of the carrier in the form of a strip.

8. An indicator according to claim 7, wherein bridges having in each case a predetermined breaking edge are arranged in the connection region of the indicators connected in strip form.

9. An indicator according to one or more of claims 4 to 8, wherein the disc-shaped carrier of the indicator consists of a plastics/metal composite foil.

10. An indicator according to one or more of claims 4 to 9, wherein the indicator is constructed as a plastics deep-drawn part which is covered by a metal foil at its surface remote from the chambers.

11. A method of producing an indicator for monitoring the temperature of chilled or deep-frozen products, substantially as herein described with reference to Figures 1 to 3 or Figures 4 to 9 of the accompanying drawings.

12. An indicator for monitoring the temperature of chilled or deep-frozen products, substantially as herein described with reference to Figures 1 to 3 or Figures 4 to 9 of the accompanying drawings.

Amendments to the claims
have been filed as follows
- 16 -

CLAIMS

1. A method of producing an indicator for monitoring the temperature of chilled or deep-frozen products, such as for example foodstuffs, medicines and the like, which indicates durably the exceeding of a critical temperature, comprising the steps of:-

a) using, as a fixed geometrical shape, one or more hollow forms arranged about an axis of rotation,

b) partially filling this hollow form or hollow forms with fluid,

c) then centrifuging the hollow form or hollow forms until the fluid is disposed in the outer circular zone of the hollow form or of the hollow forms,

d) cooling the rotating hollow form or hollow forms during the centrifuging until the fluid present in the outer circular zone of the hollow form or hollow forms solidifies.

2. An indicator for monitoring the temperature of chilled or deep-frozen products, which indicates durably the exceeding of a critical temperature, wherein the indicator consists of a circular-ring-shaped hollow form (chamber) which is subdivided, by dividing walls arranged concentrically to the axis of rotation, into circular-ring-shaped cavities which are separated from one another, and each cavity is filled at least partially with a freezable fluid.

3. An indicator for monitoring the temperature of chilled or deep-frozen products, which indicates durably the exceeding of a critical temperature, wherein the indicator is constructed as a disc-shaped carrier, in which one or more chambers arranged in radial distance from an axis of rotation are arranged.

4. An indicator according to claim 2 or 3, wherein the freezable fluids are differently coloured and have different melting temperatures of, for example, -14°C, -8°C and +1°C.

5. An indicator according to claim 3, wherein the cross-section of each chamber in the radial edge region remote from the axis of rotation narrows along with the formation of a capillary gap.

6. An indicator according to claim 3 and one or more of claims 4 and 5, wherein several indicators are respectively connected together one-sided on a narrow side of the carrier in the form of a strip.

7. An indicator according to claim 6, wherein bridges having in each case a predetermined breaking edge are arranged in the connection region of the indicators connected in strip form.

8. An indicator according to one or more of claims 3 to 7, wherein the disc-shaped carrier of the indicator consists of a plastics/metal composite foil.

9. An indicator according to one or more of claims 3 to 8, wherein the indicator is constructed as a plastics deep-drawn part which is covered by a metal foil at its surface remote from the chambers.

10. A method of producing an indicator for monitoring the temperature of chilled or deep-frozen products, substantially as herein described with reference to Figures 1 to 3 or Figures 4 to 9 of the accompanying drawings.

11. An indicator for monitoring the temperature of chilled or deep-frozen products, substantially as herein described with reference to Figures 1 to 3 or Figures 4 to 9 of the accompanying drawings.

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