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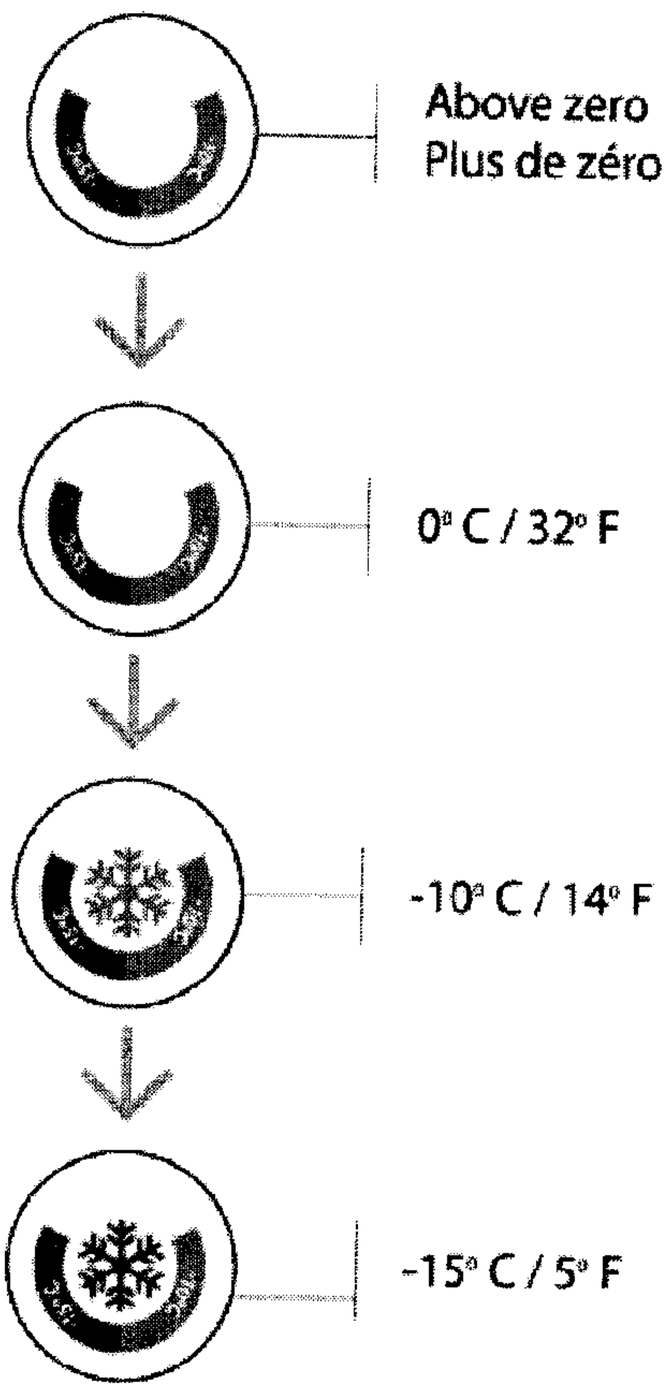
(71) Demandeur/Applicant:
LUVGEAR INC., CA

(72) Inventeur/Inventor:
MILLER, NEIL, CA

(74) Agent: VALADARES LAW GROUP LLP

(54) Titre : PROCEDE DE FABRICATION DE DISPOSITIF INDICATEUR COMPRENANT UNE SUBSTANCE DE TRANSITION COUPLEE A UN TEXTILE

(54) Title: PROCESS FOR MANUFACTURING INDICATOR DEVICE COMPRISING A TRANSITION SUBSTANCE COUPLED TO A TEXTILE



(57) Abrégé/Abstract:
A process for manufacturing an indicator device comprising at least one transition substance coupled to a textile or fabric material. The process comprises the steps of applying at least one transition substance to the textile followed by applying a polymer coating

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(57) Abrégé(suite)/Abstract(continued):
over the transition substance and curing the coated textile. The indicator device can thereafter be subjected to washing, dry cleaning, bleaching or exposure to heat and/or light.

ABSTRACT

A process for manufacturing an indicator device comprising at least one transition substance coupled to a textile or fabric material. The process comprises the steps of applying at least one transition substance to the textile followed by applying a polymer coating over the transition substance and curing the coated textile. The indicator device can thereafter be subjected to washing, dry cleaning, bleaching or exposure to heat and/or light.

PROCESS FOR MANUFACTURING INDICATOR DEVICE COMPRISING A TRANSITION SUBSTANCE COUPLED TO A TEXTILE

FIELD OF THE INVENTION

The present invention pertains to the field of indicator devices, particularly indicator devices comprising transition substances coupled to textiles, and processes of manufacturing same.

BACKGROUND

Use of transition substances, such as thermochromic and/ or photochromic dyes, is known in the art for manufacturing indicator devices and apparel, wherein change in colour of the transition substances is used to indicate change in an ambient condition.

U.S. Patent No. 6,504,161, discloses a radiation indicator device comprising a radiation sensitive mixture which undergoes a colour change which is visually recognizable when exposed to UV radiations. The radiation sensitive mixture includes an organic halogen constituent capable of producing at least one acidic product upon exposure to ultraviolet radiation and an indicator constituent capable of producing a change in colour in response to a change in concentration of the acidic product. The radiation sensitive mixture has a first colour representing a relatively low concentration of the acidic product and has a second colour representing a relatively high concentration of the acidic product. The first colour is visually distinguishable from the second colour. The device may also include a graphic pattern interposed amongst the radiation sensitive mixture, which graphic pattern has a graphic pattern colour substantially identical to either the first colour or the second colour.

U.S. Patent No. 6,858,555 discloses a colour changing water toy having a porous absorbent core made from soft open cell foam, and is covered with colourful graphics, at least one of which are printed with thermochromically sensitive paint or dye.

U.S. Patent No. 4,601,588 discloses a temperature-indicating sheet which, when exposed to temperatures higher than the prescribed temperature in temperature-control for the common low-temperature preserved goods, changes in colour according to the exposure temperature and time. The sheet of this patent comprises a component which melts at the prescribed

temperature, a substance which changes in colour in contact with the component and a membrane permeable to the molten component. The component is included in microcapsules which can be broken by outer pressure at a temperature used, and in which the component and the substance are arranged at the opposite sides with respect to the membrane.

U.S. Patent No. 6,990,688 discloses use of thermochromic and/ or photochromic dyes in the manufacture of waterproof apparel, wherein the use of thermochromic and/ or photochromic dyes are incorporated into the resin mix for fabricating the flexible sheet material.

U.S. Patent No. 5,985,381 discloses methods for increasing the camouflaging effect of any camouflaging pattern, by coating a photochromic material over at least a portion of the camouflaging pattern.

The majority of the transition substances of the prior art are incorporated into the fibers used in the manufacture of the fabric. In few cases the dyeing or printing methods are used to apply the transition substances to the fabric materials. With respect to textile/fabric materials dyed or coated with the transition substances, there exists a problem with respect to the durability of such coated or dyes materials and, in particular, with respect to colour fastness, wash fastness etc.

SUMMARY OF THE INVENTION

The present invention relates to a process of manufacturing indicator devices involving coupling of at least one transition substance to a textile/fabric material. The process of the present invention provides indicator devices with increased durability, in particular with respect to wash fastness and/or colour fastness under various conditions such as repeated washing, dry cleaning, bleaching or exposure to heat and/or light.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 illustrates an embodiment of the indicator device formed by the process of the present invention showing the transition and non-transition substances applied in a predetermined shapes and colours, wherein the non-transition substance becomes visible upon colour

change in the transition substance with a change in temperature from above 0 degrees C to below -15 degrees C;

Figs 2a and 2b illustrate other embodiments of the indicator device formed by the process of the present invention showing the transition and non-transition substances applied in predetermined shapes and colours, wherein the non-transition substance becomes visible upon colour change in the transition substance with a change in temperature from about normal body temperature to above 38 degrees C; and

Fig. 3 illustrates another embodiment of the indicator device formed by the process of the present invention showing the transition and non-transition substances applied in predetermined shapes and colours, wherein the non-transition substance becomes visible upon colour change in the transition substance with a change in ultraviolet (UV) radiation detection from little or no UV radiation detected to a relatively high degree of UV radiation detected.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

The term "condition" is used to define an existing state, with reference to an entity including but not limited to a living being or inanimate object. Examples of existing states, include but are not limited to, temperature state, pressure state, moisture state, ultraviolet radiation state, or other state which may change or transform in an identifiable manner in response to a stimulus, as would be readily understood by a worker skilled in the art. The existing state may also be with reference to the environment proximate to the entity, including but not limited to the atmospheric state proximate to an entity or state of a second entity proximate to a first entity.

The term "identifiable change" is used with reference to a change in a transition substance that can be detected including, but not limited to, changes that can be detected by one or more unassisted human senses or with the assistance of instruments and the like.

As used herein, the term "about" refers to a +/-10% variation from the nominal value. It is to be understood that such a variation is always included in any given value provided herein, whether or not it is specifically referred to.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs.

Process of the Present Invention

The present invention provides a process for manufacturing an indicator device comprising at least one transition substance coupled to a textile or fabric material. The process of the present invention generally comprises the steps of applying at least one transition substance to the textile followed by applying a polymer coating over the transition substance; and curing the coated textile. The transition substances used in the process of the invention are configured to change in the presence of or in response to a change in the condition/state.

The process of the present invention may further comprise a step of applying a non-transition substance to the textile. The non-transition substance can be applied before or after the application of the transition substance. The non-transition substance can be applied under, over and/or adjacent the transition substance.

The non-transition substance can be applied in specific colours, forms or shapes to provide further information and/or signals about the change in a condition as indicated by the transition substance. The non-transition substance can also be applied in specific colours, forms or shapes to provide a reference point for comparing the degree of change and/or intensity of the stimulus causing the change in that condition. For example, the non-transition substance can be applied in the same colour as the final colour of the transition substance to indicate the end point or the maximum level of a stimulus causing the change.

The non-transition substance can be applied to be visible subsequent to colour change in the transition substance. The non-transition substance can be applied to gradually be revealed with the corresponding change in colour of the transition substance. For example the non-transition substance can be applied under a transition substance, which masks the non-

transition substance initially and gradually changes from a dark colour to a light colour thereby gradually revealing the non-transition substance.

The process may further comprise the step of drying the non-transition substance after application.

The process may further involve the steps of drying the textile after applying the transition substance and/or non-transition substance and/or after applying the polymer coating.

The process may further include a step of applying an acrylic coating to the textile/fabric material before the step of applying the transition and/or non-transition substance in order to impart strength to the material for handling during the coupling process and to improve the wash fastness of the indicator device under various washing conditions and/or to prevent fraying if the textile material/fabric is cut.

The process may further comprise a step of preliminary curing after applying the transition substance and/or polymer coating to enhance the durability of the indicator device.

In one embodiment of the invention, the process comprises the steps of applying an acrylic coating to the textile, applying a non-transition substance to the textile, drying the non-transition substance, applying a transition substance on the textile; drying the transition substance; applying a polymer coating to the non-transition and transition substances; and curing the textile.

The process of the present invention can be carried out by printing, screening or other method as would be readily understood by a worker skilled in the art. Suitable printing processes include rotary printing, where the ink is applied to the fabric using a rotary drum. In other embodiments, a screen printing process machine, a roto print machine, stamping machine, or Flexo print machine may be used to couple the transition substance to the textile.

In another embodiment of the present invention, the transition substance is a dye, wherein the fabric material can be dipped into the dye enabling the coupling thereof with the fabric material. A worker skilled in the art would readily understand a number of ways to couple a transition substance in the form of a dye with a fabric material, wherein the selection of

apparatus can depend on how much and/or where the transition substance is to be coupled with the fabric material.

The amounts of the transition and non-transition substances applied on the material depend upon the type of transition desired on the final product and the nature of the stimulus to achieve the transition (*i.e.* thermochromic, photochromic etc.).

In one embodiment of the process is carried out in a screen printing machine, wherein the transition, non-transition and/or polymer coating is applied using a silk screen.

In one embodiment of the process, one or more of the transition and non-transitions substances is substantially or completely free of phthalates and other undesirable compounds.

In one embodiment of the invention the transition substance is applied to have a thickness of about 120μm after burning out cotton.

In one embodiment of the invention the non-transition substance is applied to have a thickness of 50-300 μm on the textile. In one embodiment of the invention the thickness of the non-transition substance is about 280 μm.

Further the amount of the non-transition and transition substances to achieve the desired thickness can be calculated by a skilled worker depending upon the apparatus used to carry out the process. The desired thickness can be achieved by using the appropriate apparatus. For example, the thickness of 50-300μm of the non-transition substance and of 120μm for transition substance can be achieved by using screen printing apparatus, wherein the mesh size of the screen is 60-220 mesh, with a gentle and even pressure.

The steps of drying the textile after application of acrylic coating, transition substance, non-transition-substance and/or polymer coating can be achieved by any method known to a worker skilled in the art. In one embodiment of the invention, the drying steps are carried out by applying hot air.

The step of curing can also be carried out according to methods known in the art. In one embodiment of the invention, the step of curing is carried out by heating the textile in curing oven at a constant temperature.

In one embodiment the step of curing can be carried out under variable temperature within a set range. In such an embodiment, the temperature increases, decreases or cycles within the range. The temperature for the curing oven can range from 150 to 300F.

As discussed above, the step of curing of the process of the present invention may further comprise a step of pre-curing. The step of pre-curing can be carried out by heating the textile on a heating element prior to heating in the curing oven. In one embodiment, the temperature of the heating element is about 200F.

Indicator Devices

Indicator devices made by the process of the present invention comprise a textile or fabric material, at least one transition substance coupled to said textile, and a polymer coating. The indicator devices can further comprise at least one non-transition substance coupled to said textile to provide further information about the change in state indicated by the transition substance.

The indicator devices formed by the process of the present invention are for indicating changes in a state, for example change in temperature, exposure to heat, light and/or ultraviolet radiations, wherein the transition substance visually transforms upon change in a state. For example the colour of the transition substance can change in response to changes in temperature, moisture, or UV radiations.

The indicator device can be configured as a sheet of material and can be used to adhere, cover, or enclose, in whole or in part an entity.

In one embodiment of the present invention, the indicator device is configured to be attached to the clothing, for example as a label.

In one embodiment of the present invention, the indicator device is an article of clothing. The described herein include for example, adult, child infant, or pet clothing, which can include shirts, blouses, t-shirts, tank tops, undershirts, hats, visors, headbands, pants, shorts, bathing suits, wetsuits, underwear, coats, jackets, jumpers, sleepers, footwear, socks, tights, leotards, gloves, mittens, wrist bands, watches or other type of clothing as would be readily understood by a worker skilled in the art.

In another embodiment of the present invention, indicator device is shaped in order to form a cover for an apparatus, for example a cover for furniture, chairs, stroller, car seats, bags, or other type of cover as would be readily understood by a worker skilled in the art. The fabric material may also be configured as a bag or other type of carrying device as would be readily understood.

In another embodiment of the present invention, indicator device is configured for a desired purpose, for example a towel, bed sheet, wash cloth, blanket, curtain, bandage, artwork, or other type of sheet-like product as would be readily understood by a worker skilled in the art.

In Fig. 1, the indicator device indicates changes in the temperature from above 0 degrees C to below -15 degrees C. As the temperature becomes colder, the colour and tone of the snowflake symbol become darker and more pronounced. This device may be coupled to a typical outer garment worn in a cold environment and may serve to alert the wearer and others as to a change in the temperature.

In Fig. 2a, the indicator device indicates changes in the temperature in contact with the device, such as a child's body temperature. When the device is in contact with the body, as the temperature rises, the device changes to reveal, for example, wording to alert the child or caregiver of the high temperature. Examples of textiles coupled to such a device include a gown, sleeper or shirt. In Fig 2 b, the indicator device can be used to indicate changes in the temperature of fluids such as bath water or drinking fluids. As the temperature of the fluid changes, so do the symbols on the device which is contact with the fluid. Examples of textiles coupled to such a device include a bathmit, bib and washcloth.

In Fig. 3, the indicator device indicates changes in the UV radiation so as to alert the wearer and others as to the likelihood of UV exposure. As the relative amount of UV radiation exposure to the device increases, for example, a symbol of the sun may become darker and more pronounced. Examples of textiles include a blanket, bodysuit and knit cap.

Further examples of garments and accessories of the present invention are contemplated.

Transition Substance

The transition substances used in the process of the invention are configured to change in the presence of or in response to a change in the condition/state. For example, the transition substance can be a material that is responsive to changes in temperature, light, ultraviolet radiation, changes in pressure, changes in atmospheric composition (e.g. the presence or absence of certain gasses in the surrounding air), changes in moisture level, changes in magnetic fields, etc. The response of the transition substance to a change in a state is a visual change, such as colour change, reflectivity change, or a transition from opaque to transparent.

In one embodiment of the present invention, the transition substance is configured to change reversibly in response to a change in a condition/state. For example, the transition substance can change colour in the presence of a stimulus which changes the condition/state and upon removal of the stimulus the transition substance can revert to its original colour.

In one embodiment of the present invention, the transition substance is configured to irreversibly change in response to a change in a condition. Upon the change of the transition substance as a result of a change in the condition, the transition substance is not capable of reverting to its original state. For example, if the transition substance changed colour due to a change in the condition, this colour change is permanent.

In one embodiment of the present invention, the transition substance is configured to respond to a change in a condition by changing from one visual representation to another. For example, the transition substance may respond to a change in a condition/state by changing from one colour to another, or from one level of reflectivity to another.

In another embodiment of the present invention, the transition substance configured to respond to changes in a condition/state in varying ranges, increments, or predetermined incremental steps. For example, the transition substance may respond to incremental changes in temperature by shifting through multiple changes in colour or shades of a particular colour. For example, an incremental change in temperature can correspond to a specific colour or a specific shade of a particular colour, for the transition substance such that when the transition substance is within a particular temperature range or increment, it is a specific

colour. For example, a transition substance may appear blue at a cold temperature, yellow as a warm temperature and red at a hot temperature. As another example, a transition substance may appear white at a first UV radiation level, light blue at a UV radiation level denoting a UV index of 5, and navy blue at a UV radiation level denoted by a UV index of 7. A worker skilled in the art would readily understand other ranges, increments or predetermined incremental steps which may be used for the identification of a defined change in a condition/state.

In one embodiment, the transition substance is configured to transform upon reaching a particular temperature or a particular UV level.

In one embodiment of the present invention, the transition substance is configured to be responsive to stimulus resulting in a predetermined change in a condition/state, wherein the change is identified by a particular threshold. For example, if the condition is temperature, the transition substance can be configured to be responsive to a particular temperature and therefore a change in the condition is represented by a temperature above or below the selected particular temperature. In one embodiment, the present invention can be used to evaluate body temperature, and the transition substance can be configured to be responsive when body heat reaches a particular level, which can be defined as a fever for example. The definition of a particular threshold for other conditions would be readily understood by a worker skilled in the art. For example, a threshold defining a particular ultraviolet radiation level, a particular pressure level or a particular moisture level.

In one embodiment, the transition substance is combined with other elements or substances so as to produce an additional result when the transition substance changes. Examples of additional substances are, for example, magnetic substances, exothermic substances, luminescent substances, and the like.

In one embodiment of the present invention, the transition substance is applied in predetermined forms, shapes, and sizes. For example the transition substance can be applied to the textile such that a predetermined image is created, wherein this predetermined image may or may not be visible in one of the original state, or changed state of the transition substance, when a condition is changed. For example, in one embodiment of the present

invention, the transition substance is transparent upon initial coupling with the fabric material and upon interaction with a stimulus which changes the condition; the transition substance becomes a particular colour. In another embodiment, the transition substance can change colour, for example from yellow to red in response to a change in a condition, or other identifiable changes in the transition substance as would be readily understood by a worker skilled in the art.

In one embodiment of the present invention, the transition substance is applied in a predetermined shape that is easy to read and understand. For example the transition substance may be formed in a predetermined shape which may be easy to understand regardless of literacy and colour-blindness. In one embodiment, the transition substance is integrated into clothing, wherein the transition substance is configured to evaluate a condition associated with the wearer. In one embodiment, the transition substance, when integrated into clothing is configured to not adversely affect the comfort of the wearer.

In one embodiment of the present invention, the preconfigured shape in which the transition substance is coupled to the fabric material is representative of the particular condition for which the transition substance is responsive to changes. In addition, for example, if the transition substance is responsive to an ultraviolet radiation state, the transition substance can be configured in the shape of the sun. And for example, if the transition substance is responsive to a temperature state, the transition substance can be configured in the shape of a thermometer. A worker skilled in the art would readily understand a variety of different shapes in which the transition substance can be configured for coupling to the fabric material, wherein the condition is represented by the shape.

In another embodiment of the present invention, the preconfigured shape of the transition substance may be that of a geometrical shape such as a square, circle, triangle, rectangle, and the like, wherein a change in a condition can be indicated by the appearance or disappearance of the geometrical shape.

In one embodiment of the present invention, the preconfigured shape and size of the transition substance is based on the number of changes in a condition that the transition substance is responsive to. For example, the preconfigured shape and size of the transition

substance can be selected to respond to one or more incremental changes in a condition such as the intensity of UV radiation level. In this embodiment, the response to each radiation level would be indicated by a different region of the transition substance.

In one embodiment of the present invention, the transition substance is a thermochromic substance. In one embodiment of the present invention, the thermochromic substance is a thermochromic ink or dye.

Examples of thermochromic substances are liquid crystals and leucodyes. In one embodiment, both classes of substances are encapsulated in suitable microcapsules. Liquid crystals change the crystal structures at rising temperature and result in colourless materials. Leucodyes require a combination of chemicals working together to change colours. This system is usually protected in microcapsules at 3-5 microns. The temperature to cause colour change ranges from –15°C (5°F) to 65°C (149°F) depending on the thermochromic inks. It takes 2-4°C to change to clear.

In one embodiment of the present invention, the transition substance is a photochromic substance. In one embodiment of the present invention, the photochromic substance is a photochromic ink or dye.

In one embodiment, the photochromic substance is formulated so that its threshold for colour change is ultraviolet radiation concentrations above UV index 5. In this embodiment the condition is the concentration of UV radiation and the threshold is the amount of UV radiation likely to cause sunburn.

Photochromic inks have special chemical structures. When photochromic inks are exposed to a UV light source, it causes the inks to undergo a temporary chemical change in which the molecules are nearly broken in half and the colour changes. When the UV source is removed, the molecules reform their original bonding structure and the colour turns back.

Examples of the thermochromic and photochromic dyes are provided in Tables 1, 2 and 3.

Table 1 Colour range of thermochromic dye

Colour	Pantone number
Red	186C
Rose red	217C
Magenta	675C
Vermillion	1785C
Orange	172C
Yellow	393C
Yellow green	359C
Charm green	373C
Green	3435C
Sky blue	2925C
Turkish blue	320C
Blue	285C
Dark blue	287C
Violet	286C
Black	Black3C

Table 2 Temperature range (clearing point) of thermochromic dye

-15°C (5°F)	31°C (88°F)
-10°C (14°F)	33°C (91°F)
-5°C (23°F)	35°C (95°F)
0°C (32°F)	38°C (100°F)
5°C (41°F)	40°C (104°F)

8°C (46°F)	43°C (109°F)
10°C (50°F)	45°C (113°F)
15°C (59°F)	50°C (122°F)
17°C (63°F)	55°C (131°F)
20°C (68°F)	60°C (140°F)
22°C (72°F)	65°C (149°F)
25°C (77°F)	

Table 3 Colour range of photochromic dye

Colour name	Colour	Colour change rate
Purple 1	Dark purple	Fast
Purple 4	Purple/blue	Slow
Blue 1	Medium blue	Normal
Blue 4	Dark blue	Normal
Blue 5	Medium blue	Normal
Blue 6	Royal blue	Slow
Blue 8	Royal blue	Slow
Blue 10	Dark Blue	Slow
Blue 13	Blue	Normal
Turquoise 1	Turquoise	Normal
Teal 1	Teal	Normal
Yellow 1	Yellow	Normal
Gold 1	Gold	Normal
Orange 2	Orange	Slow

Orange 3	Dark orange	Slow
Rose 1	Rose	Normal
Rose 2	Burgundy	Normal
Red 1	Red	Slow
Red 2	Red	Normal
Red 5	Brick red	Slow
Plum 1	Plum	Slow
Plum 2	Plum	Slow
Grey2	Gray/purple	Slow

Non–Transition substance

As discussed above, in one embodiment the indicator device formed by the process of the present invention comprises a non-transition substance coupled to the textile. The non-transition substance can be applied under, and/or adjacent to the transition substance.

In one embodiment of the present invention, the non-transition substance is applied, alone or in combination with other elements, to the textile in predetermined forms, shapes, and sizes, which are visible either before or after the transition substance visually transforms upon a change in a condition.

For example, in one embodiment of the present invention, the non-transition substance is applied in combination with a transition substance, which transforms from transparent/colourless to a particular colour on change in a state. In such an instance the non-transition substance would be visible initially and would be covered by the colour of the transition substance after transformation thereof.

In one embodiment the non transition substance is applied in a predetermined shape or pattern that is easy to read and understand. In one embodiment of the present invention, the preconfigured shape in which the non-transition substance is coupled to the fabric material is

representative of the particular condition which the transition substance is responsive to changes therein. For example, if the transition substance is responsive to an ultraviolet radiation state, the non-transition substance can be configured in the shape of the sun. And for example, if the transition substance is responsive to a temperature state, the non-transition substance can be configured in the shape of a thermometer or a water droplet.

In one embodiment, the non transition substance is applied in the shape of sun when used with the transition substance that is photochromic. In one embodiment of the invention, the non-transition substance is applied in the form of words, for example, ALERT, HOT ALERT, etc., when used in combination with transition substance that is thermochromic.

In another embodiment of the present invention, the preconfigured shape of the non-transition substance may be that of a geometrical shape such as a square, circle, triangle, rectangle, and the like.

In one embodiment of the present invention, the non-transition substance is applied in a predetermined colour which is representative of a reference for comparison relating to the condition indicated by the transition substance. For example, in one embodiment the non-transition substance, is applied in the form of a red outer circle and the transition substance is applied in the shape of a sun or marked as "SUN ALERT", wherein the transition substance is invisible in the absence of light and/or UV radiations and assumes the red colour of same intensity as the outer circle to indicate the highest levels of UV radiations.

Various types of non-transition substances known in the art can be used in the process of the present invention. Such substances include, but not limited to reactive dyes, direct dyes, vat dyes and pigments etc.

Acrylic Coating

In one embodiment of the invention, the textile/fabric material is coated with an acrylic coating before the step of applying the non-transition substance and/or transition substance. The acrylic coating is applied to impart strength to the material for handing during the coupling process and to improve the wash fastness of the indicator device under various washing conditions, for example including bleach, dry cleaning.

Various types of acrylic coatings known in the art can be used in the process of the present invention. Non limiting examples of such acrylic coatings include poly(methyl methacrylate) [PMMA], poly (butyl methacrylate) (PBMA), poly (ethyl methacrylate) (PEMA), and poly (ethyl methacrylate-co-butyl methacrylate) [P (EMA-BMA)] etc.

Polymer Coating

In one embodiment of the invention, the textile material is coated with a polymer coating after applying the transition substance and/or non-transition substance. Again, the polymer coating to applied to improve the durability of the indicator device, in particular under various washing conditions, exposure to varying temperatures, light and/or heat.

Various types of polymer coatings can be used in the process of the present invention. Non limiting examples of such polymer coatings include, polybutadiene, polybutadiene derivatives, polyurethane, polyurethane derivatives, styrene-butadiene, acrylonitrile-butadiene, acrylonitrile-butadiene-styrene, acrylonitrile-ethylene-styrene, polyacrylates, polychloroprene, ethylene-vinyl acetate, etc.

Textile/Fabric Material

The textile/fabric material used in the process of the present invention can be a natural or man-made type sheet of material, for example a cotton material (100% cotton, poly/cotton blend)), polyester material, nylon material, acrylic, rayon, felt material, leather material, wool material, hemp material, plastic material, or vinyl material.

Suitable labels can include vinyl or fabric patches, 100% cotton label tape, 100% polyester label tape with fused or woven edges, or label tapes that are blends of polyester and cotton or other label configurations as would be known to a worker skilled in the art.

In one embodiment of the present invention, the colour of the fabric material is neutral. In another embodiment, the fabric material is coloured. The selection of the colour of the fabric material can be based on the predetermined shape of the transition substance, and/or the specific transition substance to be coupled to the fabric material. For example, the colour of the fabric material can be chosen to be the same as that of the transition material before it has

changed and to contrast with the colour of the transition material after it has changed in response to stimulus.

The invention will now be described with reference to specific examples. It will be understood that the following examples are intended to describe embodiments of the invention and are not intended to limit the invention in any way.

EXAMPLES

Example 1

In an exemplary embodiment the process of the present invention involves a process for making a roll of labels for affixing to articles for determining, for example, whether the temperature of bath water is too high. This process involved providing a roll of cotton ribbon that is coated with acrylic coating. A non-transition dye is then applied on the ribbon in the form the word ALERT using silk screen having a mesh size of 60-200 mesh with a constant, gentle and even pressure. The dried area of the roll is then dried with dry air for 10-15 seconds. After the drying step, the coloured (e.g., blue or violet) thermochromic dye is applied in form of a water drop on the labels over the word ALERT. The thermochromic dye is also applied using the silk screen having a mesh size of 60-200 mesh with a constant, gentle and even pressure. After applying the thermochromic dye, the dyed areas of the labels are dried again with hot air for 10-15 seconds. Then the label roll is coated with ACRAMIN or APPERTAN (polymer coating) using the silk screen having a mesh size of 100-200 mesh. After applying the polymer coating the ribbon is passed over a heating plate at about 200 degree F for 7-10 seconds to pre-cure the ribbon. The ribbon is then rolled again and cured in a curing oven at a temperature of 200degree F.

In this example, the thermochromic transition dye is coloured when the temperature of the bath water is within an acceptable range, and loses its colour to reveal the non-transition dye ALERT image below, when the temperature of the bath water is higher than 37.6C.

Example 2

In an exemplary embodiment the process of the present invention involves a process for making a roll of labels for affixing to articles of clothing to identify whether a person's body

temperature is above normal. This process involved providing a roll of cotton ribbon that is coated with acrylic coating. A non-transition dye is then applied on the ribbon in the form of the word ALERT using silk screen having a mesh size of 60-200 mesh with a constant, gentle and even pressure. The dried area of the roll is then dried with dry air for 10-15 seconds. After the drying step, the coloured (e.g., blue or violet) thermochromic dye is applied in form of a thermometer on the labels over the word ALERT. The thermochromic dye is also applied using the silk screen having a mesh size of 60-200 mesh with a constant, gentle and even pressure. After applying the thermochromic dye, the dyed areas of the labels are dried again with hot air for 10-15 seconds. Then the label roll is coated with ACRAMIN or APPERTAN (polymer coating) using the silk screen having a mesh size of 100-200 mesh. After applying the polymer coating the ribbon is passed over a heating plate at about 200 degree F for 7-10 seconds to pre-cure the ribbon. The ribbon is then rolled again and cured in a curing oven at a temperature of 200degree F.

In this example, the thermochromic transition dye is coloured at a normal body temperature, and loses its colour to reveal the non-transition dye ALERT image below, as the body temperature approaches 38 C.

Example 3

In an exemplary embodiment the process of the present invention involves a process for making a roll of labels to indicate high levels of UV exposure. This process involved providing a roll of cotton ribbon that is coated with acrylic coating. A non-transition dye is then applied on the ribbon in the form of a pink circle using silk screen having a mesh size of 60-200 mesh with a constant, gentle and even pressure. The dried area of the roll is then dried with dry air for 10-15 seconds. After the drying step, the photochromic dye is applied on the labels in the shape of a sun, within the pink outer circle. The photochromic dye is also applied using the silk screen having a mesh size of 60-200 mesh with a constant, gentle and even pressure. After applying the photochromic dye, the dyed areas of the labels are dried again with hot air for 10-15 seconds. Then the label roll is coated with ACRAMIN or APPERTAN (polymer coating) using the silk screen having a mesh size of 100-200 mesh. After applying the polymer coating the ribbon is passed over a heating plate at about 200

degree F for 7-10 seconds to pre-cure the ribbon. The ribbon is then rolled again and cured in a curing oven at a temperature of 200degree F.

In this example, the photochromic transition dye is non-coloured at a low level of UV exposure, and becomes coloured as the level of UV exposure increases to indicate a level of UV exposure beyond an acceptable threshold level.

What is claimed:

1. A process for manufacturing an indicator device comprising at least one transition substance coupled to a textile, comprising the steps of:

a) providing said textile;

b) applying said at least one transition substance to said textile;

c) drying the applied said at least one transition substance;

d) applying a polymer coating over said applied at least one transition substance to provide a coated textile; and

e) curing the coated textile.

2. The process according to claim 1, wherein said transition substance is thermochromic substance, or photochromic substance.

3. The process according to claim 1 or 2, wherein the curing step e) comprises heating the textile in an oven.

4. The process according to claim 3, wherein the curing step e) further comprises heating the textile on an heating element before heating in the oven.

5. The process according to any one of claims 1 to 4, further comprising a step of applying at least one non-transition substance to the textile prior to the step of applying the at least one transition substance.

6. The process according to any one of claims 1 to 4, further comprising the step of applying at least one non-transition substance to the textile after the step of applying the at least one transition substance.

7. The process according to claim 6 or 7, further comprising a step of drying the textile after applying said at least one non-transition substance.

8. The process according to claim 7, wherein said drying is achieved by applying hot air.

9. The process according to any one of claims 5 to 8, wherein said non-transition substance comprises reactive dyes, direct dyes, vat dyes or pigments.

10. The process of claim 9 wherein said non-transition substance is substantially or completely free of phthalates and other undesirable compounds.

11. The process according to any one of claims 5 to 10, wherein said at least one non-transition substance is applied via a silk screening method.

12. The process according to any one of claims 5 to 11, wherein said non-transition substance is applied to have a thickness of 50-300μm.

13. The process according to any one of claims 1 to 12, further comprising a step of applying an acrylic coating to said textile before step b).

14. The process according to claim 13, wherein said acrylic coating comprises poly(methyl methacrylate), poly (butyl methacrylate), poly (ethyl methacrylate), poly (ethyl methacrylate-co-butyl methacrylate) or a mixture thereof.

15. The process according to any one of claims 1 to 14, wherein said polymer coating comprises polybutadiene, polybutadiene derivatives, polyurethane, polyurethane derivatives, styrene-butadiene, acrylonitrile-butadiene, acrylonitrile-butadiene-styrene, acrylonitrile-ethylene-styrene, polyacrylates, polychloroprene, ethylene-vinyl acetate or mixtures thereof.

16. The process according to claim any one of claims 1 to 15, wherein in step b) said at least one transition substance is applied to said textile via a silk screening method.

17. The process according to any one of claims 1 to 16, wherein said transition substance is applied to have a thickness of about 120μm.

18. The process according to any one of claims 1 to 17, wherein said textile is a fabric material.

19. The process according to any one of claims 1 to 17, wherein said textile is provided in the form of an article of clothing.

20. The process according to any one of claims 1 to 17, wherein said textile is provided in the form of a label to be configured to be attached to an article of clothing.

21. The process according to any one of claims 1 to 17, wherein said fabric is provided in the form of a roll.

22. The process according to any one of claims 1 to 17, wherein said fabric is provided in the form of a flat sheet.

23. An indicator device formed by the process of any one of claims 1 to 22.

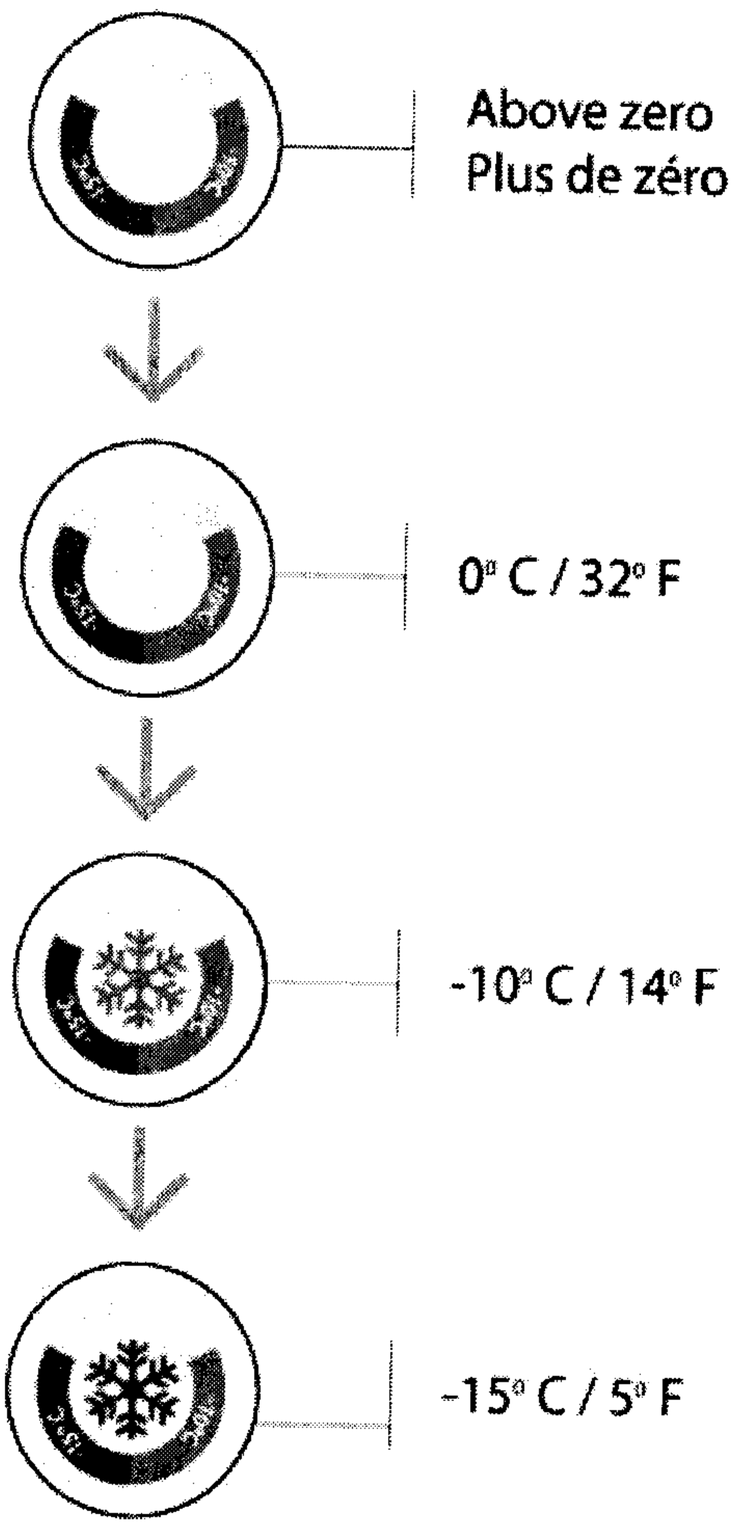


Fig. 1

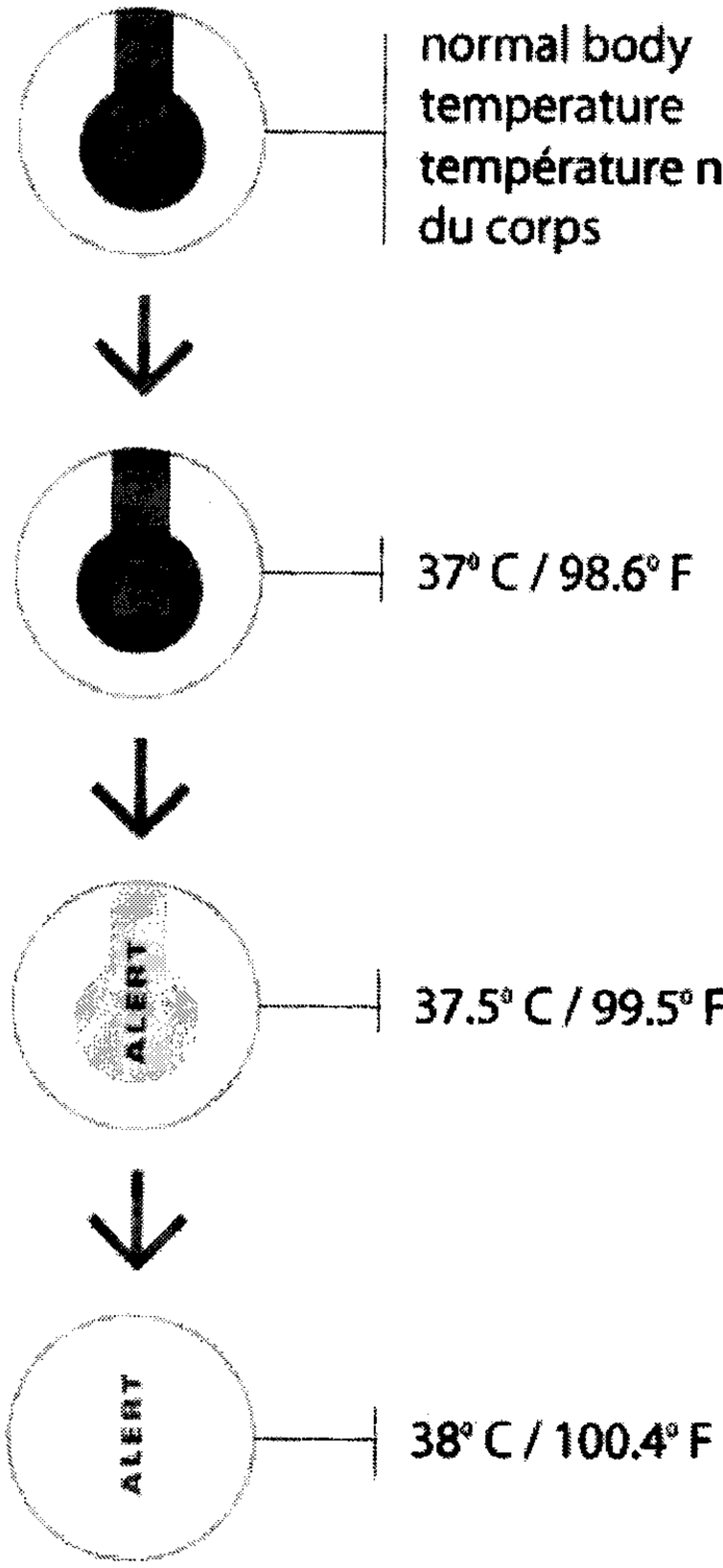

normal body
temperature
température normale
du corps
37° C / 98.6° F
ALERT
37.5° C / 99.5° F
ALERT
38° C / 100.4° F

Fig. 2a

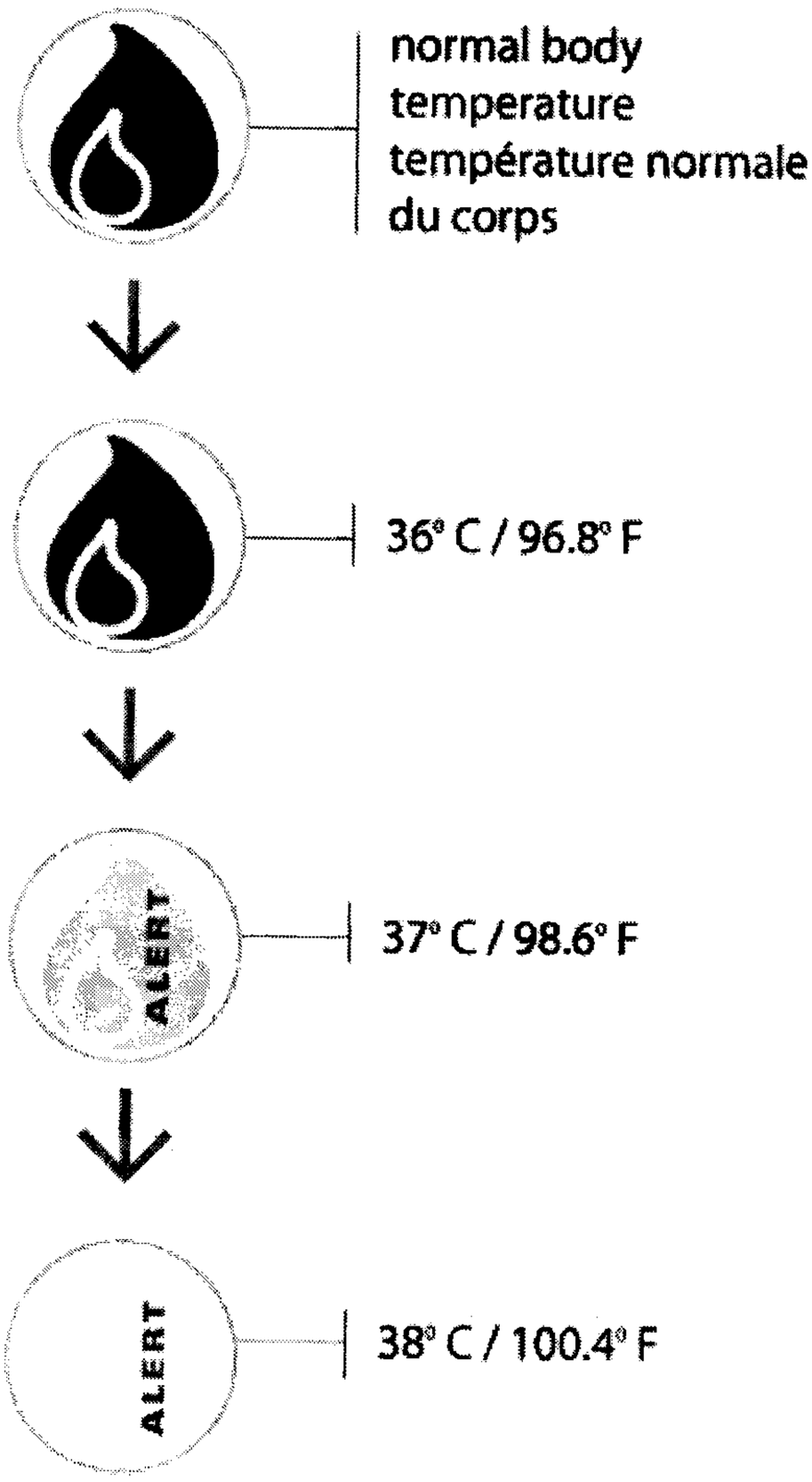

normal body
temperature
température normale
du corps
36° C / 96.8° F
ALERT
37° C / 98.6° F
ALERT
38° C / 100.4° F

Fig. 2b

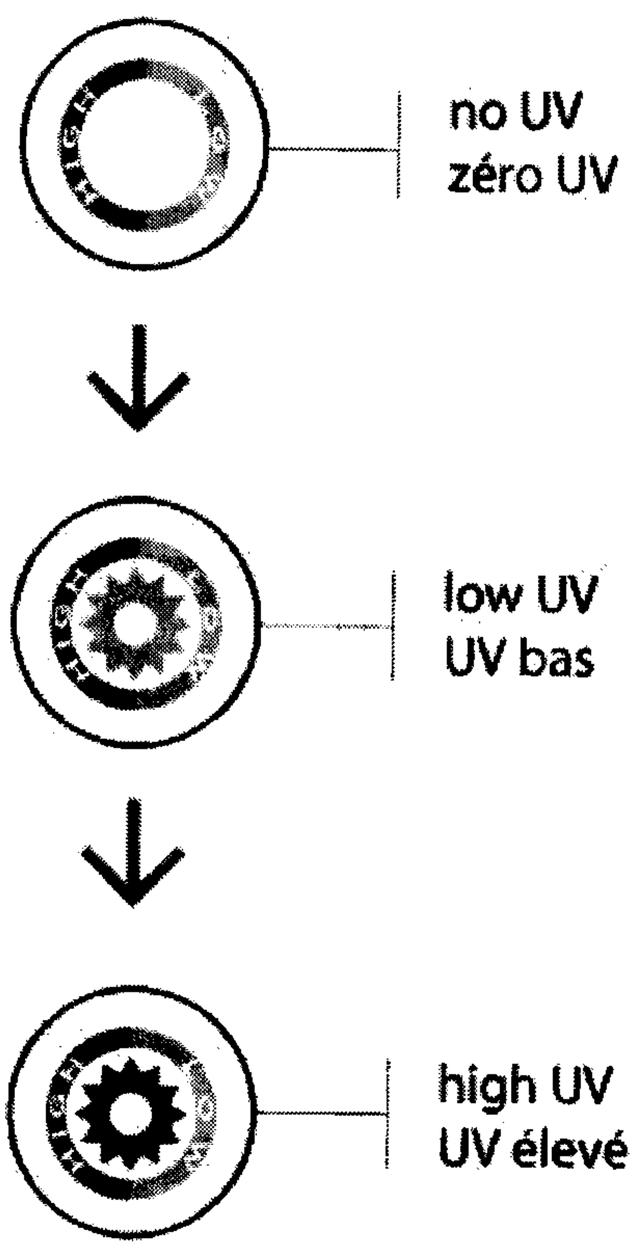
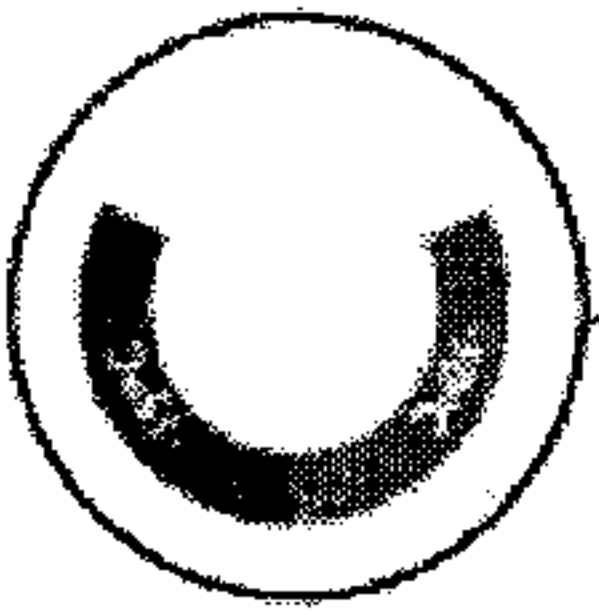
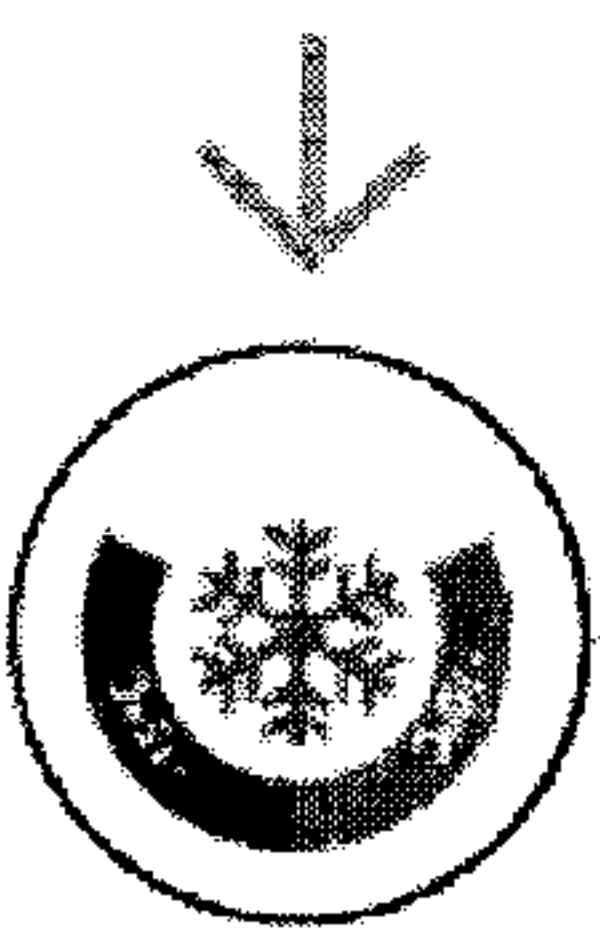


Fig. 3

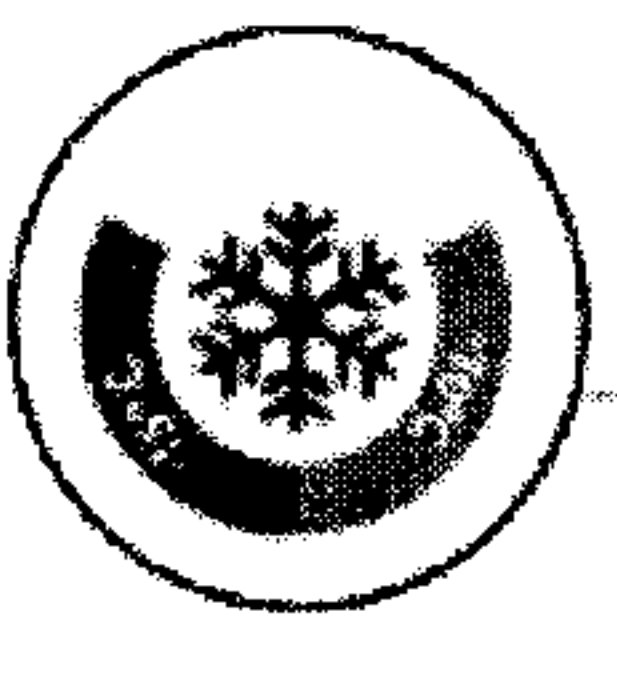


Above zero
Plus de zéro

0° C / 32° F



-10° C / 14° F



-15° C / 5° F