DEVICE FOR APPLYING A COMPOSITION ON HUMAN KERATINOUS MATERIAL

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ABSTRACT
A device for applying a cosmetic composition on human keratinous material, the device comprising: a non-colorimetric detection system; an application system for applying the composition to keratinous material, comprising a reservoir containing the cosmetic composition; and a processor unit for controlling the application system as a function at least of data received from the detection system.
FIG. 1

Detect non-colorimetric magnitude → Analyze

Adjust optional tolerance zone → Wait for confirmation (if any) → Apply

FIG. 2

DETECTION SYSTEM → APPLICATION SYSTEM

PROCESSOR UNIT

USER INTERFACE
DEVICE FOR APPLYING A COMPOSITION ON HUMAN KERATINOUS MATERIAL

[0001] The present invention relates to treating human keratinous material, in particular by applying a cosmetic, i.e. non-therapeutic, or dermatological composition.

BACKGROUND

[0002] It is known to mask the blemishes that may be present on the skin by applying makeup compositions, where such blemishes may be situated for example on the face, the hands, the bust, the neck, or the entire body.

[0003] By way of example, these blemishes may be differences in color or non-uniformities in relief such as recesses, dilated pores, or small scars. Non-uniformities of relief may be accompanied by non-uniformities of color, because of shadow effects.

[0004] Although some of these non-uniformities are well accepted, many people are not at ease with some or all of the non-uniformities presented by their skin. This is particularly true of non-uniformities on skin that is easily seen, e.g. the face, the hands, the bust, or the scalp.

[0005] In order to mask these non-uniformities, a conventional approach consists in depositing a layer of covering composition that masks the non-uniformity by going beyond it in all directions. The technique is quite simple since it does not require great accuracy. Its drawback is that the result is not very natural.

[0006] Another approach consists in covering the non-uniformity in a masking composition in highly accurate manner. That approach in which only the blemish itself is covered requires a great deal of attention and rapidly becomes time-consuming when the skin presents several non-uniformities, as often happens on the face, the hands, or the neck.

[0007] Furthermore, the non-uniformities that are located in areas that are difficult or impossible to see, e.g. the top of the scalp or certain zones of the arms or the neck, it is necessary to have the help of another person in order to apply the composition.

[0008] Consequently, there exists a need to camouflage blemishes of keratinous material in a manner that is accurate and not too constraining for the user.

[0009] Publication WO 2007/02195 A1 discloses a method of applying makeup in which an agent that modifies the reflectance of the skin is applied to the skin by using ink jet printer technology. In one embodiment, the device includes a scanner and an ink jet printer, and in a single pass over the skin it analyses the skin, identifies unattractive characteristics, calculates the improvements to be made, and applies the agent that modifies reflectance so as to obtain these improvements. For example, the device can give a softer appearance to the skin by identifying pale and dark points and by applying the reflectance-modifying agent so as to darken pale points using a predefined averaging technique. The device may include means for recognizing the treated zone, e.g. the cheek bone or the cheek so that the improvements made are specific to the zone being treated, e.g. making cheeks look rosy so as to give the appearance of a person in better health, or darkening zones under the cheek bones so as to make them less prominent. A colorant may be deposited on certain portions of the skin to make it more uniform and markers that fluorescence under ultraviolet illumination may be used to make it easier to recognize certain regions during treatment. In an example seeking to simulate tanning, an agent that modifies the spectral characteristics of the skin is applied so as to reduce contrast between pale and dark zones, darkening zones of the skin in selective manner, while causing certain details of the skin to disappear. In another element, pale zones around wrinkles are darkened but the hollow zones within wrinkles are not modified.


[0011] U.S. Pat. No. 6,543,893 describes an ink jet printer suitable for being moved manually over the skin. The printer may have a screen for displaying images that are to be printed and a device that enables the image to be personalized, e.g. by adding text or other information.

[0012] U.S. Pat. No. 6,622,723 describes an applicator having an ink jet printer head.

[0013] Application US 2006/0098076 discloses a system for ink jet printing on the skin that includes means for positioning the face. The printer system is suitable for printing hairs on the eyebrows or for printing color on the cheeks for blending in with a brush.

[0014] Application WO 2001499 A2 describes a method of applying makeup by means of a movable applicator head supported by an arm that is articulated so as to follow the three-dimensional shape of the zone being made up. The three-dimensional shape is acquired with the help of one or more cameras. A design selected by the user can be printed using an ink jet. The printing may serve to cover a pigment mark with the same color as the surrounding skin, after performing colorimetric analysis thereon.

[0015] Application DE 10153249 A1 describes a method of applying compositions on the skin by means of an ink jet printing technique. Printing may be performed using a handle-piece held by the user. In a variant, the print head may move relative to the skin by moving a belt or a carriage on a rail that is itself movable on two sideways at its ends.

[0016] Application JP 2006-297691 discloses a printer system for printing an image on the skin, the system being fitted with means that enable the color of the skin to be measured. The printer system takes account of the color of the skin in the image that is to be reproduced, the print head being provided with a photodetector. For example, for a dark skin, the quantity of ink is increased. In a variant, not only is the lightness of the skin taken into consideration but also its color when calculating the image for printing.

[0017] Publication GB 2 343 657 describes a portable ink jet printer suitable for printing a mark authorizing entry to a concert or a discotheque on the forearm or the hand of a person. The ink that is deposited may be visible, fluorescent, magnetic, phosphorescent, or photoluminescent.

[0018] Application WO 2008189 A1 describes a method of applying a colored composition on the skin in which it is possible to select a blemish on an image of the zone for treatment, which image is obtained by means of a camera that also measures color. Image modification software makes it possible to correct a blemish in the zone for treatment, e.g. a depigmented zone, by outlining the zone with the help of a computer mouse and then printing on the correct zone the color of the surrounding zone.

[0019] Publication WO 03/032370 discloses an ink jet printer that can be positioned manually on the skin in order to print a tattoo.

[0020] Publication US 2007/0114306 describes an electrostatic spray device for making up the skin.
U.S. Pat. No. 7,190,550 discloses an installation capable of printing on the skin, in particular on the skin of the face.

Numerous appliances are also known for printing on the nails, e.g., from U.S. Pat. Nos. 5,931,166 and 6,035,860.

**SUMMARY**

First exemplary embodiments of the invention provide a device for applying a composition on human keratinous material, the device comprising:

- a non-colorimetric detection system;
- an application system for applying the composition to keratinous material; and
- a processor unit for controlling the application system as a function at least of data received from the detection system.

The device may include a handpiece including the detection system and the application system, and possibly also the processor unit.

The device may easily be used as an "intelligent applicator" by the person desiring to apply, and/or a care product, without needing help from another person. The device may nevertheless also be used by a professional in a beauty parlor, for example. The device may be manufactured at a cost that is compatible with large-scale distribution.

The invention may be used specifically for treating non-uniformities or other blemishes of keratinous materials, without being necessary to pay particular attention to the handling of the handpiece. The invention thus enables zones to be treated that are difficult or impossible to see.

The device may be configured to enable detection and application to be performed in a single pass while moving the handpiece over the keratinous material.

The term "non-colorimetric" should be understood as meaning that detection is based on something other than measuring color.

The detection system may thus be sensitive to soundwaves, to moisture, to at least one predefined chemical or biological compound, to at least one mechanical or electrical magnitude, to temperature, and/or to relief.

Detecting soundwaves may provide information about friction and surface state, and conductivity measurements may provide information about hydration.

Other exemplary embodiments of the invention also provide a treatment method, in particular a cosmetic treatment method, e.g., by applying a composition, in particular a cosmetic, on human keratinous material, the method comprising:

- automatically detecting a zone for treatment of the keratinous material, detection being performed with the help of a non-colorimetric detection system; and
- treating the zone as detected in this way, e.g., by applying the composition to said zone. The treatment may be performed automatically.

The keratinous material may be formed by the skin, the lips, the fingernails, or the hair.

The application system may include at least one print head enabling the composition to be projected onto the keratinous material without the print head coming into contact with the keratinous material.

The application system may also apply the composition by means of an applicator member making contact with the keratinous material. The application system may thus include an applicator member that is secured to the handpiece, being movable between a composition application position where it is in contact with the keratinous material, and a position where it is spaced apart from said keratinous material. The applicator member may be selected from endpieces, in particular flocked endpieces, or foam endpieces, paint brushes, applicators that retain composition by capillarity, felt tips, membranes, porous bodies, beads, rollers, transfer films, and flexible media.

By way of example, when in the application position, the applicator member may have an area of contact with the skin that lies in the range 1 square millimeter (mm²) to 2500 mm².

The composition may be transferred onto the keratinous material by capillarity. The composition may optionally be deposited as a result of the speed of impact of the applicator member against the keratinous material and/or of the force with which the applicator member is pressed against the keratinous material.

The applicator member may be secured to a moving portion carrying a reservoir containing the composition for application, and the applicator member may communicate with the reservoir via a capillary wick or via a channel, the channel being formed within the movable portion, for example. The movable portion may be magnetic so as to enable it to be set into movement by a magnetic field created by an excitation coil.

Where appropriate, advantage may be taken of the movement of the applicator member to enhance impregnation of the applicator member with composition. When it moves, the applicator member may release a duct, possibly under pressure, so as to enable one or more components to be injected. When it moves, the applicator member may also create a suction effect for entraining a liquid.

The applicator member may move against the action of a resilient return member that may serve to brake the applicator member and avoid it making contact with the keratinous material that is too violent.

The device may include an actuator secured to the handpiece for moving the applicator member between said positions. The device may control the actuator to bring the applicator member automatically into engagement with the keratinous material. The actuator may be selected from actuators that are electromagnetic, electronic, hydraulic, motor-driven, thermal, piezoelectric, or that rely on electrochemical polymers. In a variant, or in addition, the device may cause a sound and/or visual signal and/or a vibration to be emitted so as to warn the user. The handpiece may be arranged to enable the user as warned in this way to bring the applicator member selectively into contact with the keratinous material. For example, the handpiece may include a button on which the user may press to control the actuator. In a variant, it is the user who moves the applicator member manually in order to bring it into contact with the keratinous material.

The processor unit is advantageously provided with a memory or makes use of a memory, with it being possible to use any kind of storage system, for example a universal serial bus (USB) key, an electrically-programmable read-only memory (EPROM), a memory card, a hard disk, or optical storage. The content of the memory may be conserved after the device has been switched off.

The device may retain values that are specific to each user. This function may be very useful for use within a family, for example.
[0048] The device may include a system for acquiring at least one tolerance zone for one or more detected characteristics. By way of example, the device may include an interface enabling the user to adjust the tolerance zone. As a function of the tolerance threshold as predefined or adjusted by the user, composition may be applied only on certain blemishes of keratinous material and not on others, e.g. because the others are less visible.

[0049] Although enabling the user to adjust a tolerance zone is not essential for proper operation of the device, given that the tolerance zone may be predefined, implementations of the invention make provision for this option. By way of example, a first approach for defining the tolerance zone consists in using numbers or a curve or a function to inform the device about limits of the tolerance zone. The adjustment data may be entered manually or it may be downloaded. The term “tolerance zone” should be understood as being a limit value or one or more ranges of values with which the result of detection may be compared, with the delivered data optionally being processed by the detection system.

[0050] The device may inform the user that detection has been performed without difficulty. Conversely, the apparatus may inform the user that it has not been possible to accomplish detection.

[0051] Several actions are possible when the device determines that application may take place. In particular, application may be triggered automatically. Where appropriate, the user may be warned that the device is ready for application to take place, but without application being triggered. For example, the result of detection may be signaled by means of light signals, a sound, or a vibration. The processor unit may then wait for some action on the part of the user. For example, the user may act on the user interface, e.g. by pressing on an application button. The user may take some other action on the handpiece, for example the user may bring the above-mentioned applicator member into contact with the zone that is to be made up.

[0052] The applied composition may be cosmetic and pigmented. The composition may be photo-polymerizable.

[0053] The composition that is applied may have a color that matches the color of the skin. The composition may be contained in a single reservoir of a composition having a predefined color or may be formed by mixing together various components contained in corresponding reservoirs.

[0054] The user may place the handpiece on the skin in the zone that is to be treated or may move the handpiece progressively as treatment takes place, causing it to slide over the skin. The user may also make use of a plurality of handpieces, e.g. for use with different parts of the body. The handpiece may be suitable for use on the hair or on the fingernails.

[0055] The device may include a source of vibration for subjecting the applicator member to vibration when it makes contact with the skin. This may cause the outline of the deposit to be less visible and/or may make it easier to transfer composition.

[0056] The device may put application on hold until detection stabilizes, or whenever the result of treatment is uncertain, atypical, or unstable. The device may continue to restart detection for as long as the result of detection varies. It is only when detected values stabilize that application is launched. If the value measured by a sensor does not stabilize, the data capture corresponding to the sensor need not be taken into account.

[0057] Other exemplary embodiments of the invention also provide a method of treating human keratinous material, in particular a cosmetic treatment method, wherein a composition is applied by means of a device as defined above.

[0058] The invention can be better understood on reading the following detailed description of non-limiting implementations hereof, and on examining the accompanying drawings, in which:

[0059] FIG. 1 shows various steps in an example method of the invention;

[0060] FIG. 2 is a block diagram of an example device made in accordance with the invention;

[0061] FIG. 3 is a diagrammatic perspective view of an example device made in accordance with the invention;

[0062] FIG. 4 is a view analogous to FIG. 3 for a variant device;

[0063] FIGS. 5 and 14 are electronic schematic diagrams of example devices;

[0064] FIG. 6 shows an example of a user interface;

[0065] FIG. 7 is a diagram of an example of an application system;

[0066] FIGS. 8 to 12 are fragmentary and diagrammatic axial section views of variant application systems; and

[0067] FIGS. 13A to 13C show steps during the operation of the FIG. 12 device.

DEVICE

[0068] In one of its exemplary embodiments and as shown diagrammatically in FIG. 2, the invention may be implemented with the help of an application device 10 that comprises: a detection system 11; an application system 12; a user interface 13; and a processor unit 14, which unit may serve to receive data from the detection unit 11 and the user interface 13, and to control the application system 12.

[0069] The processor unit 14 is made with the help of any computer or electronic means, e.g. a microcomputer, a microcontroller, a programmable logic array, or by any analog and/or digital means enabling calculations to be performed.

[0070] The device 10 may be used to implement the method having the steps set out in FIG. 1.

[0071] The method comprises a step 20 of detecting a non-colorometric characteristic of human keratinous material, a step 22 of analyzing data derived from the detection, e.g. for the purpose of determining whether the data lies within a tolerance range, if so application is not triggered, or on the contrary lies outside the tolerance range, and if so application is triggered in a step 24.

[0072] Application may be initiated as a function of a decision threshold, also referred to a tolerance zone, and this threshold may be adjusted by the user in a step 26.

[0073] The method may be implemented iteratively, i.e. once an application has been performed, the device returns to detection step 20.

Treatment

[0074] Treatment may be performed wherever the device detects a zone presenting predefined characteristics. This treatment may comprise applying a composition.

Compositions

[0075] The composition(s) applied will generally be in fluid form, and may be based on water or on solvent and
contain dyes that are natural or artificial, optionally fluorescent, optionally phosphorescent, pigments that may be organic and/or inorganic, mixtures of these compounds, or indeed materials that are not colored but that produce optical effects.

[0076] The compounds contained in the composition may be in dispersion, may be dissolved, or they may be in an emulsion. They may also form a mixture that is relatively unstable, and that may need to be made uniform at the time of application.

[0077] The composition(s) may be contained in reservoirs that are easy to fill or to remove and replace.

[0078] The composition(s) may contain photo-protective agents such as UV filters or pigments, or a mixture of colored and photo-protective ingredients.

[0079] In one particular utilization the composition is not colored. This utilization is particularly advantageous for people having zones that they desire to protect from the sun, e.g. beauty spots, or zones lacking in pigmentation.

[0080] The composition(s) may contain additives, and in particular holding agents and/or cosmetic agents, e.g. selected from polymers, surface-active agents, oils, waxes, silicones, fragrances, adhesives, glues, photosensitive or thermosensitive materials, gelling or thickening agents, antibacterial agents.

[0081] The composition may contain active agents selected for example from docosahexaenoic acid (DHA), sun filters, depilatory compositions, bleaches, depigmenting agents, peeling compositions.

[0082] The composition(s) may be inks adapted from printing technology, and also adapted to the color that is desired.

[0083] The inks used are preferably fluid and may be based on water or on organic solvents and may include at least one coloring agent selected from natural or artificial dyes that may optionally be fluorescent or phosphorescent, organic and/or inorganic pigments, and mixtures thereof.

[0084] The ink may include one or more non-colored materials that provide optical effects, for example a fuzzy effect.

[0085] Where appropriate, one of the printed compositions may be a base coat or a top coat in order to improve the retention of the inks, for example.

[0086] The coloring agent(s) and the non-colored agent(s) that are optically active may be in a dispersion, dissolved, or in an emulsion. The may also form a mixture that is not very stable, and which may need to be remixed or redispersed at the time of use.

[0087] By way of example, the inks are disposed in a cartridge of a group of cartridges so as to be easy to remove and replace.

[0088] It is possible to use one or more ink cartridges of colors that correspond for example to the primary colors cyan, magenta, yellow, and black, or to colors that are close to skin color (pink, ochre, beige, ivory, brown, . . . )

[0089] In an implementation of the invention, a single print nozzle is used together with a plurality of ink cartridges of predefined colors. For example one to 1000, e.g. 16 colored inks are used representing a set of colors that are usually to be found on the skin: pale beige, yellowish beige, pinky beige, . . . All of the cartridges may be connected to a print head and the device may modulate the flow rate of each of the cartridges towards the print head as a function of the color that is to be printed, with modulation being performed, for example, with the help of electrostatic microfluidic technology.

Handpiece

[0090] The detection system 11 and the application system 12 may be grouped together with a single handpiece 60, as shown in FIG. 3.

[0091] This handpiece 60 may also include all or part of the user interface 13, which may include for example an on/off button, an optional slider to adjust the tolerance threshold from which application is triggered, and an indicator lamp for indicating that the detected zone is suitable for receiving composition.

[0092] The handpiece 60 may comprise a casing having secured thereto, at least while the device is in use, the detection system 11 and the application system 12, together with the user interface 13.

[0093] The handpiece 60 may house the processor unit 14, or in a variant the processor unit may be remote, with the handpiece 60 being connected to the processor unit 14 as shown in FIG. 4 by means of a connection 66 which may be wired or wireless, for example.

[0094] As shown, the handpiece 60 may include an end portion 67 for bringing into contact with or close to the skin, with detection and composition application taking place through the end portion.

[0095] The detection system and the application system may be in a single housing and close together. In a variant, the detection system and the application system may be in a single housing but spaced apart from each other. Under such circumstances, and for example, the device may include means for detecting that the handpiece is moving relative to the keratinous material, so as to enable application to be performed in a position that is identified relative to the detection.

[0096] The means for detecting movement may comprise, for example: one or more wheels and one or more optical sensors of the kind to be found in a computer mouse, for example.

[0097] The detection and application systems may be housed in two different casings that the user may optionally bring together during utilization. Thus, if the detection system warns the user about the presence of a blemish, the user may for example secure the application system to the detection system, e.g. by engaging one within the other. The two systems may include electrical and/or fluid flow connectors that co-operate when the systems are assembled together. By way of example, the detection system may include a channel opening out into the detection zone and enabling fluid to be transferred from the application system to the skin.

[0098] In another example, if the detection system warns the user of the presence of a blemish, the user may merely raise the detection system and present the application system to the same location.

[0099] The detection system and the application system may be connected together by a wired or wireless connection, for the purpose of transferring information. The detection system may inform the application system about the nature or the amplititude of the blemish, so that the application system adjusts the nature and the quantity of compound to be applied.

[0100] In another example, the user has two apparatuses, one containing the detection system and the other containing the detection system and the application system. The user can use the first apparatus, and when it detects a blemish and
issues a warning about the presence of the blemish, the user removes it and places the second apparatuses on the corresponding zone of skin. The second apparatus then searches for the blemish and applies the composition. This may enable an initial search for blemishes to take place using lightweight apparatus. It is only once the system has found the blemish that the user needs to apply the application system, which is often heavy. A second advantage is that the visibility of this approach since it enables numerous compounds to be used depending on the detected blemish. Thus, the user may have a collection of reservoirs adapted to a variety of blemish situations. When the detection system detects a blemish, it can instruct the user to make use of one or another of the reservoirs containing a compound suitable for treating the blemish in question, for example by marking it.

In the example of FIG. 3, the handpiece is elongate in shape, however the shape of the handpiece could naturally be modified without going beyond the ambit of the present invention.

Application System

The application system may include a print head.

Any print technology can be suitable.

Mention can be made in particular of offset printing, gravure printing, flexography, silk-screen printing, pad printing, electrophotography (also known as xerography, electrostatic printing, or laser printing), thermal printing (including in particular simple thermal printing, thermal transfer printing, or thermal sublimation printing), electrophotography, toner jet, magnetic toner jet, ion jet, electron beam imaging, or electrographic), and ink jet printing (including in particular so-called "continuous ink jet" and "drop on demand" technologies).

Ink can be ejected as a jet or as droplets by a piezoelectric element, by a thermal element (bubble jet), by hot-melting, or by means of a valve (valve jet).

Mention may also be made of impact printing techniques, such as for example hammer or chain printing, needle dot matrix printing, daisy wheel printing, thimble printing, and techniques such as minispray, gas printing, compressed air printing, liquified gas printing, fluidized pressure printing, such as for example airbrushes or minisprays obtained by a moving part, e.g. a moving piezoelectric crystal.

It is also possible to use printer means comprising a movable print element such as a sponge, a felt, a paint brush, a hollow tube, or a syringe, that contains ink that is put into contact with the skin for printing purposes. Contact time may be adjustable and may vary for example over the range 1/100th of a second (s) to several seconds.

The term "printing" is used to mean delivering a composition onto the surface of the material to be treated, and in particular the skin. In the meaning of the invention, printing relates to delivering the composition onto or beneath the surface for treatment. Thus, printer means using needle printing technology can enable the ink to penetrate into the stratum corneum, the epidermis, or the dermis. For this purpose, it is possible to use strong needles or brittle needles, or the like.

The application system may have a single print nozzle or a plurality of nozzles in parallel. The printer system may have nozzles that are dedicated to respective inks, or in a variant it may have a single nozzle for ejecting a plurality of different inks in succession or mixed together while printing is taking place so as to create the color that is to be printed.

The print head may be spaced apart from the skin so as to avoid coming directly into contact with the skin. This spacing may be fixed or adjustable. It is possible to adjust the spacing either directly, e.g. by turning a knob or by acting on an adjustment button that controls the movement of a motor, or else automatically. For automatic adjustment, the processor unit controls a motor to change the spacing.

If it is desired to perform sharp printing, the spacing can be adjusted to a small value, e.g. one millimeter or less, and conversely, if it is desired to perform fuzzier printing it is possible to adjust the spacing to a greater distance, e.g. 1 cm or more.

The application system may include a print head capable of printing over the entire surface for treatment. By way of example, the print head may include one or more ink ejection nozzles. Assuming that the user moves the handpiece along an axis X, the print head may extend perpendicularly to the travel direction X of the apparatus.

The print head may be stationary within the apparatus or it may be movable along an axis Y that is perpendicular to the axis X. For example, the apparatus may be used to perform scanning in a Y direction of the print head with or without printing taking place during carriage return. The carriage may be driven by stepper motors, e.g. motors that are addressed directly by a USB port.

When the handpiece has a plurality of print heads that are stationary within the handpiece, the print heads may be in alignment or otherwise, for example they may be in a staggered configuration.

The handpiece may include an application system with at least one print head that is capable of moving relative to the above-mentioned carriage, along an axis Z that is perpendicular to the axes X and Y.

The print head may be actuated mechanically during printing, e.g. by means of a vibrator, in order to obtain a fuzzy effect.

The handpiece may include a vacuum or blower system in order to accelerate drying, and/or a heater system.

When the composition deposited on the keratinous material requires exposure to light radiation, e.g. UV radiation, in order to polymerize, the handpiece may include a corresponding lighting system for assisting the polymerization of the composition(s) concerned.

The application system may have a print line made up of a plurality of print elements disposed along a print line. By way of example the print elements may be nozzles that enable the color for printing locally to be created on printing.

The printing may take place by depositing a plurality of inks of different colors in juxtaposed manner or in a manner that is at least partially superposed. The deposited slots of different inks may optionally have the same size.

The area of skin may be entirely covered by the ink(s), or gaps may be left between the deposits of ink. Inks may be deposited on the skin in a silk-screen configuration.

When an image is printed on the skin, the image need not be uniform, i.e. printing may make use of at least one ink that is deposited in non-uniform manner over the area that is being treated.

The device may include a monitoring system enabling the user or the device to determine whether printing is satisfactory or whether printing needs to be continued or corrected. By way of example, the monitoring system uses the acquisition system or includes a specific color detector or camera. For example, the device may reproduce the skin that
is being treated on a screen. Although hidden by the device, the skin can be viewed by the user, thereby enabling the user to access the result while it is being achieved.

[0124] Since the movement of the handpiece is not necessarily rectilinear, it is possible to provide for treatment that is “point-to-point” as opposed to “line-to-line” so that printing takes place in identified positions relative to the skin even if the path followed by the handpiece is curved.

Application of a Composition Having a Color Matching a Skin Color

[0125] The application system may apply a composition having a color that has been selected to match a skin color, even where the composition is obtained by mixing of components of different colors outside the device.

[0126] For example, the handpiece may send data related to the color of the skin to a mixing unit. The mixing unit may mix two or more components to obtain a mixture having a color that matches the color of the skin. In some embodiments, the user may use an independent mixing unit, that is configured to analyse the skin and to mix at least two components to produce a mixture having a color which matches the analyzed skin. The mixing unit may be used at, e.g., home, a point of sale, or at any suitable location.

[0127] In other embodiments, the handpiece may send data relating to the color of the skin to a decision unit. The decision unit may be located remotely and may be configured to identify, e.g., from a library of products, a product having a color that matches the color of the skin.

[0128] In other embodiments, the user uses a decision unit. The decision unit is capable of analyzing the skin, to identify, e.g., in a library, a product having a color that matches the color of the skin. The mixing unit may be used, e.g., at home, at a point of sale, or at any suitable location.

[0129] The user may load a composition in the handpiece. The user may also load a product at a plurality of times throughout a particularly time frame (e.g., monthly, weekly, daily, (many times a year), to adapt the color of the composition to natural variations of skin color at various times during the time period, and to the ambient light at different times (e.g., of the year) among other things.

[0130] The user may load one or more compositions in the handpiece. The latter may analyse the color of the skin, either at each use of the device and/or on a regular basis (e.g., not each time the device is used). The device may automatically select the product to be used or alert the user that the user may load a specific product into the device. The device may store (e.g., in a memory) data that will allow identification of a product that matches at least one color of skin or may have access to a memory that will allow such an identification.

[0131] In some embodiments, a color of the skin is measured at a time t and products are made having colors corresponding to the colors that are expected during a time At (e.g., during the year) for an individual. The products may be made by mixing components of various colors (e.g., by the user himself/herself identifying the products in a library of products) or by other suitable methods. The range of products and corresponding colors may be determined by software that computes the evolution of skin color according to personal data and/or general data. For example, if the skin color is measured in winter, one may make a plurality of products, for example four products, one product corresponding to the skin color as measured, and the other products corresponding to expected colors at spring, summer, and autumn. Notably, any suitable time period may be used, and use of the seasons is intended as exemplary only.

[0132] The software may utilize, for example, statistical rules of evolution of the color of different categories of skin during the year for making such determinations related to colors.

[0133] The software may also take into account personal factors such as, for example, the user’s surroundings, a user’s life style habits, the places and dates of holidays/vacations and other suitable factor.

[0134] In some embodiments, the software may take into account weather data such as sun exposure.

[0135] The device may, by analyzing the color of the skin, either at each use or on a regular basis but not necessarily at each use, select a product and use this product, or it may alert the user that he may load a specific product. This may store in a memory or have access to a memory that will allow identification of the product that matches or is closest match to the color of the skin. The device may comprise a timer that provides information relating to particular time periods (e.g., calendar dates) and may facilitate selection of the product to use.

[0136] The software may comprise a learning system that may enable improvements in the predictions.

[0137] One may pre-set the color of the composition. One may set, in a precise manner the color later, using the preselect color and adding to such preselect color, additional color components. The first setting may be done at for example, a store and the later setting may be made at, for example, home, either in the device itself or outside the device.

[0138] It may be possible to identify a color that matches the color of the skin and to make or select at least two products having colors that are different from the current matching color with for example the current color of the skin between them.

EXAMPLE 1

Contact Application System

[0139] FIG. 7 shows an example of an application system 12 of the kind that can be found in the handpiece 60. The application system 12 may comprise a casing 69 that is stationary relative to a housing 63 of the handpiece, with an electromagnet 85 being contained therein serving to move a moving portion 86 along an axis Z against the action of a resilient return member 87. This member limits stroke and attenuates movement so as to avoid any sudden impact against the skin.

[0140] In the example shown, the movable portion 86 carries the applicator member 90 that is to come into contact with the keratinous material when the electromagnet 85 is electrically excited.

[0141] When excitation of the electromagnet 85 ceases, the resilient return member 87 returns the movable portion 86 rearwards.

[0142] In order to damp the return movement of the movable portion 86, the application system 12 may include a damper member 95, e.g. formed by a resilient return member that is compressed when the upward movement of the movable portion 86 exceeds a predefined stroke.
The movable portion 86 may include a reservoir 100 containing the composition for application on the keratinous material, and in communication with the applicator member 90.

By way of example the reservoir 100 is made of plastics material and is open at one end.

The applicator member 90 may be a porous felt tip that communicates with the reservoir. Thus the composition contained in the reservoir migrates by capillarity through the applicator member.

The movable portion 86 may be made magnetic by means of an iron ring, e.g. having a length of about 2 centimeters (cm). The reservoir 100 may be adhesively-bonded to the ring.

By way of example, the winding 85a of the electromagnet may be contained in a soft iron part 85 that is U-shaped, with a hole in the middle. A U-shape has the advantage of concentrating the magnetic field created by the winding in its center, thereby attracting the movable portion by moving it to the left in FIG. 7.

In a variant that is not shown, the application system 12 is movable relative to the housing 63 of the handpiece against the return action of a resilient return member, and the application system 12 may be secured to a skirt for coming into contact with the skin. Preferably, the skirt is made of an elastically-deformable material so as to match the shape of the region being treated.

Processor Unit and User interface

The base station and/or the handpiece may contain an electromagnet carrying the processor 14, its memory 206, e.g. of the EPROM type, an analog-digital converter 208, an oscillator 209, clocked at 24 megahertz (MHz), for example, a power module 210, and a general power supply 215.

By way of example, the processor unit 14 is a programmable logic array, e.g. from the supplier Altera under the reference Cyclone III EPC3.

As shown in FIG. 6, four buttons 220 and three liquid crystal displays 200 may be carried by a front plate that is incorporated in the handpiece or in the base station, with the displays and the buttons being connected to the processor unit 14, e.g. via a serial connection.

On being switched on, the program that controls the operation of the processor unit is loaded from the memory 206.

As shown in FIG. 5, the device may also include an on/off button 277, and an indicator lamp 278 informing the user that an out-of-tolerance zone has been detected. By way of example, the lamp 278 is placed on the handpiece, as shown in FIGS. 3 and 4.

By way of example, the converter 208 is an AD7794 converter having six inputs from the supplier Analog Device, and it may incorporate a six-input analog multiplexer.

By way of example, the power module 210 comprises an operational amplifier and a power stage including power transistors suitable for generating currents of several amps for the purpose of exciting the coil 85a and of setting the movable portion 86 of the application system into motion, as described with reference to FIG. 7.

Detection System Responsive to Soundwaves

The handpiece may include a microphone in order to sense noise representative of rubbing against the skin.

By way of example, the device is made with the electronic circuit described above with reference to FIG. 5 and the application system of FIG. 7.

A microphone 310 may be fastened to the casing 69 as shown in FIG. 8, the microphone 310 being constituted for example by a unidirectional microphone of the kind sold by the supplier Projects Unlimited, under the reference PUM 35461-R.

It is also possible to fasten a ring 315, e.g. a PTFE ring at the front of the handpiece. The ring 315 is in contact with the skin and creates a noise in the event of roughness. It allows the movable portion 86 of the print head to pass through its center.

The handpiece is connected to the base station via a sheet containing the connection wires that enable the microphone to be connected to the analog-to-digital converter, and containing the print control cable from the power module 210.

The processor unit 14 performs several functions in this example:

1) data capture from the four adjustment buttons 220. Each button 220 serves to vary a register either by incrementing it or by decrementing it, e.g. a register encoded on 8 bits, with this applying to two registers referred to as S<sub>low</sub> and S<sub>high</sub>;

2) controlling the converter 208 that continuously receives analog data from the microphone 310, via an operational amplifier 224, e.g. of the kind sold by the supplier Analog Device under the reference OP27GSZ. It transforms the analog data representing sound volume into sequential digital values in the form of 16-bit numbers delivered at a rate of 100 Hz;

3) digital data capture from the converter 208, received via a serial link 229, e.g. of the serial peripheral interface (SPI) type;

4) converting the numerical value for sound volume from 16 bits to 8 bits and storing it in a register referred to as S<sub>measured</sub>;

5) sending the values of the three registers S<sub>mode</sub>, S<sub>meas</sub> and S<sub>measured</sub> to the displays 200. This is done for example over a serial link in the form of ASCII code.

Comparison operations may be performed by the processor unit 14, namely:

S<sub>measured</sub> may be compared with S<sub>low</sub> and S<sub>high</sub> as follows:

if S<sub>measured</sub> is greater than S<sub>low</sub> and S<sub>high</sub>, the processor unit instructs printing with a pulse of duration d1, e.g. 1/50th of a second (s);

if S<sub>measured</sub> is between S<sub>low</sub> and S<sub>high</sub>, the processor unit turns on the indicator light 278 that is present on the handpiece.

The processor unit thus enables the duration of the pulse delivered to be adjusted if the result of the logical operations is to lead to printing. Two print durations d1 and d2 may be provided, e.g. having respective lengths of 1/50 s and 1/5 s.

During printing, i.e. while the movable portion is advancing towards the skin, capture from the microphone is ignored. The apparatus cannot be activated by the noise it makes itself.

Operation

The reservoir 100 is filled with a dispersion of fresh colored pigments.

The base station is switched on.
EXAMPLE 2

Handpiece

In this example, the handpiece has a plurality of print heads, e.g. four print heads, that are disposed side by side as shown in FIG. 9, for example, each print head being 2.5 cm wide for example with the print heads being spaced apart from one another by 0.5 cm. The applicator members 90 of the various print heads may be wider than the associated reservoirs, for example.

The ring 315 of the example of FIG. 8 is replaced by four sets of teeth 318, each tooth being 1.2 mm wide and 1 cm long, for example, with two consecutive teeth being spaced apart by 1.2 mm, for example. By way of example, the teeth have rounded ends. Each set of teeth 318 is 2.5 cm long, for example.

The sets of teeth 318 are placed ahead of the applicator members 90 in the travel direction of the handpiece, e.g. by 5 mm, and by way of example they are fastened to the rear face of the handpiece by a vibration-absorbing material, e.g. a gasket made of elastomer, e.g. silicone.

The four unidirectional microphones are placed close to the sets of teeth 318, facing the skin.

The four print heads may be actuated independently of one another by the base station.

The four corresponding reservoirs are filled with a care product, e.g. a silicone-amine at 2% by weight in a 80:20 mixture of water/ethanol.

[0175] The memory 206 contains the values \( S_{\text{max}} \) and \( S_{\text{min}} \). Optionally, the user adjusts the values of the registers \( S_{\text{max}} \) and \( S_{\text{min}} \).

[0176] The handpiece is brought up to the skin. The user may place it wherever desired, but it is advantageous to place it in a zone that contains blemishes for correcting directly, e.g. the cheeks.

[0177] The user can move the handpiece over the skin.

[0178] As soon as the device detects a zone outside the threshold \( S_{\text{max}} \), the lamp 278 is switched on, indicating that roughness is coming close to the threshold from which printing is triggered.

[0179] As soon as the apparatus detects a zone beyond \( S_{\text{action}} \), the base station sends an instruction to the handpiece to perform application. Current is generated in the coil 85a. As a result the movable portion 86 moves towards the skin under the effect of the magnetic field from the coil. Contact is very brief and the movable portion returns rearwards. The applicator member 90 has made contact with the skin and has transferred color.

[0180] Since the device triggers printing only on zones of roughness that lies outside tolerance, it follows that printing is very well localized.

[0181] The user may change ink either to change its color or its covering power, or else its texture or grain.

[0182] The user may also change \( S_{\text{max}} \) or \( S_{\text{min}} \) by acting on a pushbutton 220, and this can be done without it being necessary to restart the apparatus.

[0183] It is possible to replace the colored composition with a care composition for example, and to treat any portion of the body such as the hair, the fingernails, the skin of the legs.

EXAMPLE 3

Handpiece

In this example, the handpiece has a plurality of print heads, e.g. four print heads, that are disposed side by side as shown in FIG. 9, for example, each print head being 2.5 cm wide for example with the print heads being spaced apart from one another by 0.5 cm.

The applicator members 90 of the various print heads may be wider than the associated reservoirs, for example.

The ring 315 of the example of FIG. 8 is replaced by four sets of teeth 318, each tooth being 1.2 mm wide and 1 cm long, for example, with two consecutive teeth being spaced apart by 1.2 mm, for example. By way of example, the teeth have rounded ends. Each set of teeth 318 is 2.5 cm long, for example.

The sets of teeth 318 are placed ahead of the applicator members 90 in the travel direction of the handpiece, e.g. by 5 mm, and by way of example they are fastened to the rear face of the handpiece by a vibration-absorbing material, e.g. a gasket made of elastomer, e.g. silicone.

The four unidirectional microphones are placed close to the sets of teeth 318, facing the skin.

The four print heads may be actuated independently of one another by the base station.

The four corresponding reservoirs are filled with a care product, e.g. a silicone-amine at 2% by weight in a 80:20 mixture of water/ethanol.
the voltage sequentially and at a rate of 100 Hz for example into digital values in the form of numbers that are coded on 16 bits, for example.

[0207] By way of example, the processor unit 14 performs the following operations:

\[ V_{\text{measured}} \text{ is compared with } V_{\text{lim}} \text{ and } V_{\text{action}}. \]

[0208] If \( V_{\text{measured}} > V_{\text{action}} \), then the processor unit 14 considers that the surface is too dry, and it instructs printing with a pulse duration \( d_p \) of \( \frac{1}{2500} \) s, for example.

[0209] If \( V_{\text{measured}} \leq V_{\text{lim}} \), then the processor unit considers that the skin is moisturized near the limit, and instructs the lamp 278 that is present on the handpiece to be switched on.

Operation

[0210] The reservoir 100 is filled with a composition for application, e.g. containing 80% water and 20% glycerol, by weight.

[0211] The memory 206 informs the processor unit 14 about the values \( V_{\text{lim}} \) and \( V_{\text{action}} \). The user optionally adjusts the values in these registers with the help of the button 220.

[0212] The handpiece is brought up to the skin. The user may place it wherever desired, but it is advantageous to place it on a zone of skin that is poorly moisturized or that is dry, e.g. a zone that is naturally dry such as the legs, for example, or a zone that has become dehydrated by treatment and exposure to low temperature or to the sun, e.g. the cheeks, arms, stomach, mucous membranes such as the lips, or the hair.

[0213] The user may move the handpiece over the skin. As soon as the apparatus detects a zone beyond \( V_{\text{action}} \) the processor unit sends an instruction to the handpiece to perform printing and a current is generated in the coil 85a. As a result, the movable portion 86, under the effect of the magnetic field from the coil 85a, is moved towards the skin.

[0214] Since the apparatus triggers printing only on zones where conductivity lies outside tolerance, it follows that printing is well localized.

[0215] The user may change the care product and switch to compositions that combine a care product and makeup or that perform makeup alone.

[0216] The user may also change the values of the registers \( V_{\text{lim}} \) and \( V_{\text{action}} \) without there being any need to restart the device.

EXAMPLE 4

[0217] The same device is used as in Example 3 except that the device includes a selector 243, as shown in FIG. 6, which selector is connected to the processor unit 14. The processor unit is programmed to record corresponding values \( V_{\text{lim}} \) and \( V_{\text{action}} \) depending on the position of the selector 243 that is selected by the operator.

[0219] The processor unit causes the values \( V_{\text{lim}} \) and \( V_{\text{action}} \) to appear on the display 200.

[0220] A button 244 connected to the processor unit 14 enables the user to record in the memory 206 the adjusted values in a correspondence table "body"-\( V_{\text{lim}} \)-\( V_{\text{action}} \).

Operation

[0221] The reservoir 100 is filled with a treatment composition containing, by way of example: 50% water, 20% ethanol, 20% glycerol, 1% silcone-amine, and 1% DHA, all percentages being by weight.

[0222] The device is switched on. The user adjusts the selector 243 on the body portion that is to be treated. The memory 206 informs the processor unit 14 about the register values \( V_{\text{lim}} \) and \( V_{\text{action}} \) from the above-mentioned correspondence table.

[0223] The user makes use of the device as in Example 3, except that the adjustment of the device is changed as often as the treatment zone is changed.

[0224] The user may change the recorded values \( V_{\text{lim}} \) and \( V_{\text{action}} \) without needing to restart the apparatus.

[0225] As testing proceeds, the user may adjust the values \( V_{\text{lim}} \) and \( V_{\text{action}} \) in a personalized manner meeting the user's tastes, for each treatment zone.

[0226] The device may be modified by giving it a system that accepts a plurality of reservoirs. Each reservoir may contain a care product that corresponds to a specific portion of the body.

[0227] Since the device is informed by the selector 243 about which portion of the body is being treated, it is capable of switching automatically from one reservoir to another. Under such circumstances, the handpiece may include not only a system having a plurality of removable reservoirs, but also a system for selecting the reservoirs, which system is put into action by the processor unit, e.g. a rotary system.

EXAMPLE 5

[0228] The same base station may be used as in Example 3. The same handpiece may be used as in Example 3, with the exception of the electrode 415, which electrodes are not arranged in the same manner.

[0229] As shown in FIG. 11, the two electrodes 415 may be placed on a clamp 420 so as to face each other when the clamp 420 is closed. The clamp 420 may open in order to receive the surface for treatment (eyelashes, hair) and then close onto said surface.

[0230] An abutment 425 may serve to prevent the two electrodes 415 from touching. The electrodes may be spaced apart by a gap of 1 mm, for example.

[0231] Once opened, the clamp 420 sends a measurement indication signal to the base station.

[0232] By way of example, the apparatus applies a care composition, based on dissolved silicone (5%) in a volatile solvent (silicone D5).

EXAMPLE 6

[0233] The detected electrical magnitude may be capacitance, and it is possible to use a detection system made up of a plurality of cells.

[0234] By way of example, it is possible to use a system of the kind used for recognizing fingerprints. The system is made up of a plurality of capacitance-measuring cells. Each cell is formed by two electrodes that measure capacitance locally. When the skin is close to two electrodes, and thus to the electric field formed by the two electrodes of the cell, the skin modifies the capacitance of the cell.

[0235] An example of a system that is suitable for this utilization is constituted, for example, by a sensor that is sold by the supplier ST Microelectronics, comprising 256x360 detection cells of size close to 50 μm and operating at 14 data captures per second. The matrix sensor may be used in association with electrodes and computer systems (drivers, PerfectPrint control system) of specifications that are given in the document "Advanced Datasheet 1C81AD-Touchchip Sili-
Handpiece

[0236] The matrix sensor, e.g. of the Touchchip® type as described above is fastened to a frame, together with a print head taken from an ink jet printer, e.g. of the Lexmark trademark. These two elements are fastened and spaced apart by one centimeter, for example, measured edge to edge. The frame also has two movement detectors fastened thereto, e.g. X and Y detectors from the supplier ETC and a referenced OM2 Optical Sensor. These detectors are interfaced for transforming perceived movements into information about the situation of the handpiece and they may be connected to an EKM8022 mouse controller circuit from the supplier Elan.

[0238] Four wheels may be positioned on the frame so that movement on the skin of the frame as a whole causes a zone of skin to begin by being positioned relative of the sensor and then relative to the print head.

Base Station

[0239] The base station may contain an ultracompact embedded PC type personal computer PC 104 from the supplier Advantech, referenced PCM 4170, associated with 256 Mbytes of synchronous dynamic random access memory (SDRAM), a mouse, a screen, and an Internet connection, and also providing four USB extension ports.

[0240] The PC is connected by respective USB ports to the electronics of the print head, to the displacement detector interface (EKM8022 mouse controller (Elan)), and it is also connected to the electronics of the matrix sensor, and that is connected to the screen, the mouse, and the keyboard.

[0241] The PC runs the software serving to warn the user when the handpiece is moved in the wrong direction, to access data from the matrix sensor, to analyze said data in order to extract recessed points, i.e. points that are not in contact with the wall of the matrix sensor, and to ignore zones that are very rich in recesses. If an entire zone containing numerous points is considered as being recessed, the processor unit does not interpret the zone as being pores or wrinkles but interprets these measurements as faulty relief measurement by the matrix sensor, e.g. because the handpiece is poorly pressed against the skin. Under such circumstances, the memory is left unchanged. Furthermore, the processor unit warns the user about the poor placing.

[0242] The processor unit may retain recessed points other than those ignored as mentioned above, so as to consider them subsequently as “skin blemishes”, such as pores or wrinkles.

[0243] The device may cause an image corresponding to the skin blemishes detected in this way to appear on the screen.

[0244] The device may calculate an image corresponding to these pores or wrinkles being filled in, where the recessed points under consideration receive printing while the others do not receive printing, and then display on the screen an image of the recesses filled in as calculated in this way, possibly superposed on the image of the skin blemish.

[0245] Given the way the handpiece moves over the skin, and relying on two movement sensors and the known spacing between the matrix sensor and the print head, the processor unit is capable of determining the moment at which the image is to be printed by the print head, line by line on the skin.

[0246] The processor unit may also be programmed to give the user a free choice concerning the color to be applied to the pores or to wrinkles. For this purpose, the interface may display a plurality of colors and simulations on the screen.

[0247] The processor unit may be programmed to leave the user free to select the color for printing as a function of the size of skin blemishes, e.g. a single color regardless of the number of pixels occupied by a blemish, or in a variant a plurality of colors associated respectively with blemishes of different sizes.

[0248] The processor unit may omit printing on blemishes that are too small, e.g. occupying one or two pixels.

EXAMPLE 7

[0249] The same device is used as in Example 6, with the exception that the ink in the print head is replaced by a dermatological (i.e. non cosmetic) or care product, e.g. a myorelaxing agent, botox, a moisturizer, or PHA.

EXAMPLE 8

[0250] The same device may be used as in Example 6, except that the ink in the print head is replaced by a photopolymerizable composition, e.g. based on polyvinyl acetate (PVA) functionalized by stybazolium functions from the supplier Murakami.

[0251] At the end of treatment, the face is exposed to light, e.g. UV A, at a density of 100 milliwatts per square centimeter (mW/cm²) for 5 s, so as to cause the composition deposited on the wrinkles to polymerize.

Temperature-Sensitive Detection System

[0252] The detection system may be sensitive to temperature, and for example it may include an infrared temperature sensor.

EXAMPLE 9

Handpiece

[0253] An application system may be made that is identical to that described with reference to FIG. 7.

[0254] A ring 410, e.g. made of PTFE, is fastened to the front in order to provide contact with the skin, leaving a central hole for passing the movable portion 86 of the print head, as shown in FIG. 12.

[0255] Two electrodes 415, e.g. platinum electrodes, each having a surface area of 50 mm², are stuck to the front face of the ring 410.

[0256] These two electrodes 415 serve to determine the ring 410 is in contact with the skin, by measuring conductivity.

[0257] A temperature detection module 505 from the supplier Dexter, referenced “Infrared Temperature Module” and making use of the ST 60 thermopile from the same supplier is placed facing the skin. The module has a response that is linear over a broad range of wavelengths and it delivers a signal that is calibrated as a function of temperature.

Base Station

[0258] As shown in FIG. 14, the base station may include two adjustment buttons 510, each button 510 serving to increment or decrement a register Tset, e.g. coded on 8 bits.

[0259] The device may include a button 301 for taking a reference temperature.
[0260] The processor unit 14 reads the pulse-width modulated (PWM) type calibrated signal delivered by the module 505, e.g. at a rate of 100 Hz, and reads the conductivity signal coming from the electrodes 415.

[0261] If conductivity is high, e.g. >1 siemens (S), then a register coded on 8 bits, for example, and referred to as “contact” is set to 1. Otherwise, the register is set to 0.

[0262] The processor unit 14 controls the application of the values of three registers $T_{\text{delta}}$, $T_{\text{reference}}$ and $T_{\text{measured}}$ which are displayed by the three displays 200.

[0263] This is performed, for example, via an ASCII-coded serial link. The processor unit may cause a green indicator light to be switched on if the contact register is at 1, and a red light if the contact register is at 0.

[0264] When the operator presses on the reference-taking button 301, and if the contact register is at 1, then the processor unit 14 stores in the register $T_{\text{reference}}$, the value $T_{\text{measured}}$, e.g. coded on 16 bits.

[0265] When the operator does not press the button 301 and the contact register is at 1, the processor unit 14 compares $T_{\text{measured}}$ with the value of $T_{\text{reference}}$.

[0266] If $T_{\text{measured}} > T_{\text{reference}} + T_{\text{delta}}$, then the processor unit 14 instructs printing with a pulse duration of $1/20$ s, for example.

[0267] If $T_{\text{measured}} < T_{\text{reference}} + T_{\text{delta}}$, then the processor unit 14 does not instruct printing.

[0268] If the contact register is at 0, then the processor unit 14 prevents the reference temperature being taken and prevents temperature being detected.

[0269] The processor unit 14 may also serve to adjust pulse duration if the result of calculation indicates that temperature is necessary, e.g. it may select between two values such as $1/8$ s and $1/50$ s.

[0270] When switched on, the contact register is set to 0 and the register $T_{\text{reference}}$ is set to 30, for example.

[0271] During printing, and thus while the movable portion is advancing towards the skin, the temperature sensor may be inactivated.

Antibacterial and Treatment Active Agent

[0272] The reservoir 100 is filled with a treatment composition, e.g. containing 80% water and 20% glycerol, by weight, together with a preservative system, formulated on the basis of an antibacterial agent.

Operation

[0273] The base station is switched on. The memory 206 informs the processor unit 14 of the values $T_{\text{reference}}$, $T_{\text{delta}}$. The user may optionally adjust the value of $T_{\text{delta}}$.

[0274] The user brings the handpiece up to the skin and may place it whenever desired, however it is advantageous to place it in a zone that is likely to prevent blemishes, such as the face or the bust.

[0275] The user measures a temperature in a portion that appears healthy. For this purpose, the user presses on the “take reference” button 301. The temperature $T_{\text{measured}}$ is then displayed on the front face of the base station, and the user releases the button 301.

[0276] The user may move the handpiece over the skin, observing the red and green contact lights, and adjusting the amount of pressure that is exerted so as to maintain contact.

[0277] As soon as the device detects a zone outside the limit $T_{\text{reference}} + T_{\text{delta}}$, the handpiece deposits the care product.

[0278] The user may change the care product and switch to compositions associated with liquid makeup alone or in composition with a deodorant or an antiperspirant.

[0279] The user may also change the value $T_{\text{delta}}$, and this can be done without it being necessary to restart the apparatus.

EXAMPLE 10

[0280] By way of example, the same device is used as in Example 9. However in this example the calculation undertaken by the processor unit is not $T_{\text{reference}} + T_{\text{delta}}$, but $T_{\text{reference}} - T_{\text{measured}}$.

[0281] In addition, it is when $T_{\text{measured}}$ is less than $T_{\text{reference}} - T_{\text{delta}}$ that printing is activated.

[0282] Any type of composition may be placed in the reservoir 100, e.g. a composition including one or more compounds for activating blood circulation, one or more temperature-regulating compounds (calcium salts), one or more irritant compounds (capsaicin), or one or more peeling compounds, e.g. glycerol acid.

Detection System Responsive to at Least One Chemical or Biological Species

[0283] The handpiece may include an invasive probe. The term “invasive probe” is used to designate a probe that penetrates into the skin, in general through a distance corresponding to the epidermis (i.e. about one hundred micrometers).

[0284] The probe need penetrate into the skin only intermittently, e.g. once every second, or when the handpiece is moved, e.g. once every centimeter.

[0285] The probe may be arranged to measure pH or moisture, or to perform a chemical measurement such as oxygen content or glucose content.

[0286] The probe may be coupled with a force measurement in order to inform the apparatus about the hardness of the skin. By way of example, this may be done by incorporating a force detector in the mechanical part that holds the probe. When the user presses the apparatus against the skin, the probe is caused to come into contact with the skin. The skin begins by resisting penetration. The force measured is relatively high. The fact that force is being measured informs the user, e.g. by means of an indicator light, that the probe has come into contact with the skin but that it has not penetrated therein. Then, by continuing to apply pressure, the user forces the probe to penetrate into the skin. This leads to a sudden drop in the measured force. The force measurement then informs the user that penetration has taken place, e.g. by lighting an indicator light of a different color. The probe may then perform its measurement and information may be sent, e.g. after a few seconds, to the apparatus.

“Moving” Mode

[0287] The handpiece may be placed on the skin and moved gently over the skin.

[0288] The device performs a first measurement using the invasive probe, e.g. a measurement of hydration level. If the measurement shows that the hydration level is low, the handpiece applies a moisturizer over an area that is considerably larger than the zone in which the measurement is made.

[0289] If the measurement shows that the hydration level is satisfactory and standard, the handpiece does not apply any composition.
When the user moves the handpiece, it takes another measurement further along, e.g. a few millimeters further along. Depending on the hydration level given by the measurement, the handpiece continues to apply moisturizer or stops applying moisturizer.

“Stationary” Mode

The handpiece is placed on a given zone.

The device takes a first measurement of the hydration level using the invasive probe.

If the measurement shows that the hydration level is low, the device applies a moisturizer over an area that is considerably larger than the zone in which the measurement was performed.

If the measurement shows that the hydration level lies within an acceptable range, the device does not apply moisturizer.

A few tens of seconds later, the device takes another measurement at the same location. Depending on the hydration level given by the measurement, the device continues or ceases to apply the moisturizer. The device needs stop only when the moisturizer has had its effect and the hydration level has reached a predefined value.

The probe may also be used to inject an active agent, whether in stationary mode or in moving handpiece mode.

EXAMPLE 11

Handpiece

It is possible to use an application system identical to that described with reference to FIG. 7.

As shown in FIG. 13, a caterpillar may be formed, e.g. having a length of four centimeters, made up of a strip 600 of rubber put under tension by two wheels 605 that are secured to the housing of the application system.

The strip 600 is placed on the front face of the apparatus, facing the skin. The wheels 605 are free and the strip is free to move relative to the handpiece when the user moves the handpiece.

A needle 610 is fastened to the strip 600. By way of example, the needle 610 is a fine aluminum spike. The needle 610 is placed so that it projects and can penetrate into the skin, e.g. to a depth of 500 μm.

The needle 610 passes through the strip of rubber and is connected to connectors 620 that are placed in parallel and adhesively-bonded to the rubber strip, e.g. using aluminum film connectors having a length of one centimeter and spaced apart by two millimeters.

A pH minielectrode is installed in the hollow spike. The two wires from the pH minielectrode are connected to the two connectors 620.

Two wipers 630 are placed between the two wheels 605 so that they automatically make contact with the two connectors when the needle goes past the wipers 630.

FIGS. 13A to 13C show how the caterpillar moves over the skin, causing the needle 610 to be pushed into the top layers of the skin, and then causing the wipers 630 to be put into connection with the connectors 620 that are placed on the strip 600, thereby enabling the pH minielectrode to be read.

Other needles including pH minielectrodes may be placed on the strip on the same principle as that described above. By way of example, the strip may have six needles with associated minielectrodes.

The assembly comprising the strip and the wipers is placed on the front face of the handpiece, e.g. being offset a little to avoid hindering printing.

An operational amplifier connected to the converter 208 amplifies the signal from the pH minielectrodes.

Base Station

Three liquid crystal displays 200 receive the values from three registers $P_{\text{min}}$, $P_{\text{act}}$, and $P_{\text{meas}}$.

The front face of the base station may include adjustment buttons enabling the registers $P_{\text{min}}$ and $P_{\text{act}}$ to be incremented or decremented, which registers are coded on 8 bits, for example.

The processor unit compares $P_{\text{meas}}$ with $P_{\text{min}}$ and $P_{\text{act}}$.

If $P_{\text{meas}} < P_{\text{act}}$ (surface too acidic), the processor unit instructs printing, e.g. with a pulse having a duration of $\frac{1}{5}$ s.

If $P_{\text{meas}} < P_{\text{min}}$, the processor unit 14 considers that the skin has a limit level of activity, and causes a light present on the handpiece to be switched on, also instructing printing, but with a pulse having a duration of $\frac{1}{50}$ s, for example.

During printing, pH-sensing may be inactivated.

Furthermore, a time lapse controlled by the processor unit, e.g. a lapse of half a second, may be allowed between successive print operations.

Operation

The reservoir 100 is filled with an aqueous composition containing ammonium carbonate buffer with pH 8.2. The composition also contains 0.3% by weight of carbomer.

The base station is switched on, with the memory informing the processor unit about the values $P_{\text{min}}$ and $P_{\text{act}}$. The values of these registers may optionally be adjusted.

The handpiece is brought up to the skin. The user may place it in any desired location, but it is advantageous to place it in a zone that is little or poorly hydrated, or that is dehydrated, e.g. a zone that is naturally dry, such as the legs, for example, a zone that has been dehydrated by treatment, or a zone that has been exposed to low temperatures or to the sun, a zone that has been subjected to the action of pollution, the cheeks, the arms, the stomach, the mucous membranes such as the lips, for example, or the hair.

When the handpiece does not read any signal coming from any one of the six pH minielectrodes, the apparatus does not perform any printing.

As soon as the device detects a zone beyond $P_{\text{min}}$, a light is switched on indicating that the pH is coming close to the limit and the handpiece begins to deposit the care product, with a printing duration of $\frac{1}{20}$ s.

Printing may continue in this mode for 2 seconds, unless some other information comes to the base station in the meanwhile.

As soon as the device detects a zone beyond $P_{\text{act}}$, the base station instructs the handpiece to perform printing, e.g. with a duration $\frac{1}{5}$ s, for depositing the care product.

Printing may continue in this mode for 3 seconds, unless some other information reaches the stationary portion meanwhile.

If the device detects a zone beyond $P_{\text{act}}$, the base station instructs the handpiece not to perform printing.
[0324] The user may change the care product and switch to compositions associating makeup with a care product, or comprising makeup alone.

[0325] The user may also change the values of the registers \( P_{\text{load}} \) and \( F_{\text{action}} \) and this can be done without any need to restart the device.

**EXAMPLE 12**

[0326] Unlike Example 11, the user begins by placing an aqueous solution of citrate buffer (pH 4.8) on the skin, e.g. one minute beforehand.

**Variants**

**Non-Invasive Chemical Detection Probes**

[0327] pH measurements may be performed in contact with the skin.

[0328] It is possible to measure the following gases: \( \text{CO}_2 \), \( \text{NO} \), CO, \( \text{NO}_2 \), for example, depending on whether it is desired to deduce biological activity or the presence of pollution.

[0329] It may be desired to detect liquid compounds having a boiling temperature close to ambient temperature, e.g. solvents and residues of fragrances, endogenous odor molecules, or exogenous odor molecules.

[0330] By way of example, it is possible to use detectors of the kind used in artificial noses, such as semiconductor compounds that are sensitive to the presence of certain volatile compounds.

[0331] It is possible to detect fatty acids, other fatty compounds, to detect DNA, amino acids, and/or proteins, or salts.

**EXAMPLE 13**

[0332] Unlike Example 11, the strip 600 contains various different probes, e.g. for measuring pH, for ensuring calcium content, chlorine content, or sodium content.

**Mechanical Detection System**

[0333] It is possible to use at least one mechanical sensor, e.g. to determine the force the skin opposes either to being pushed in, to being rubbed, or to being turned.

[0334] By way of example, it is possible to use force sensors from the supplier Honeywell.

[0335] It is also possible to use multipoint sensors. Such sensors are in the form of a matrix of spikes. The electronics of the sensor provides information concerning the pressure as received by each spike. The spike may be spaced apart by less than one millimeter. The sensors may be made up of several tens or several hundreds of spikes.

[0336] The invention is not limited to the examples described. It is possible within a single handpiece to combine a plurality of detection systems of different types, such as those described above, for example.

[0337] The term "comprising a" should be understood as being synonymous with "comprising at least one".

1. A device for applying a cosmetic composition on human keratinous material, the device comprising:
   - a non-colorimetric detection system;
   - an application system for applying the composition to keratinous material, comprising a reservoir containing the cosmetic composition; and
   - a processor unit for controlling the application system as a function at least of data received from the detection system.

2. A device according to claim 1, configured to enable detection and application to be performed in a single pass.

3. A device according to claim 1, the detection system being sensitive to soundwaves.

4. A device according to claim 1, the detection system being sensitive to moisture.

5. A device according to claim 1, the detection system being sensitive to at least one predefined chemical or biological compound.

6. A device according to claim 1, the detection system being sensitive to at least one electrical magnitude.

7. A device according to claim 1, the detection system being sensitive to temperature.

8. A device according to claim 1, the detection system being sensitive to all the above.

9. A device according to any claim 1, including a user interface for adjusting at least one threshold beyond which application is performed, as a function of data coming from the detection system.

10. A device according to claim 9, enabling a first threshold and a second threshold to be adjusted, application taking place from the second threshold, and the device warning the user when the results of detection lie between the first and second thresholds.

11. A method of applying a cosmetic composition on human keratinous material, the method comprising:
   - automatically detecting a zone for treatment of the keratinous material, detection being performed with the help of a non-colorimetric detection system; and
   - applying a cosmetic composition to the zone as detected in this way.

12. A method according to claim 11, the keratinous material being formed by the skin.

13. A method according to claim 11, application being performed automatically by a device that is moved over the keratinous material and that includes a non-colorimetric detection system.

14. A method according to claim 11, the detection system being selected from detection systems that are sensitive to soundwaves, to moisture, to at least one predefined chemical compound, to at least one electrical magnitude, to temperature, and/or to portions in relief.

15. A method according to claim 11, being performed by an applicator making contact with the skin.

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