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(54) HAIR CARE DEVICE AND METHOD

(57) A hair care system uses a temperature sensor to create a map of hair temperature. This is processed together with a target temperature map to determine an amount of heating needed to separate locations of the hair. An output is generated to guide a user to provide the required determined amount of heating to those separate hair locations.

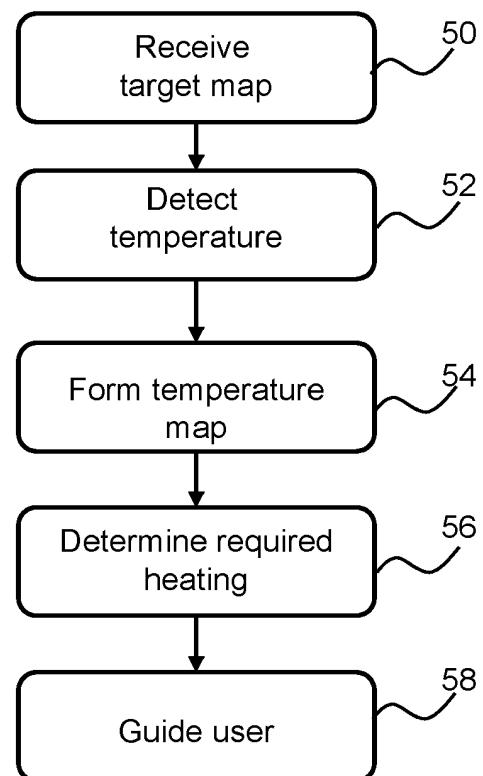


FIG. 2

Description**FIELD OF THE INVENTION**

[0001] This invention relates to hair care, and in particular hair care during which heat is applied to the hair. One example is hair dryers, and in particular blow dryers.

BACKGROUND OF THE INVENTION

[0002] Various hair care routines involve the application of heat. A main example is drying the hair using a hair dryer such as a blow dryer. However, heating the hair is also used in hair curlers and hair straighteners.

[0003] A correct temperature is an important aspect of these hair care routines. For example for blow drying hair, a higher temperature means quicker drying, but it can negatively affect hair quality and/or cause skin issues like dryness.

[0004] Typically, a standard hair dryer has only minimal temperature control, such as with a low, medium, or high temperature setting. Users are left to their own experience and sensation to apply the appropriate amount and duration of heat.

[0005] High-end blow dryers have embedded temperature sensors that detect the temperature of the hair and automatically adjust the temperature to prevent overheating and maintain natural moisture levels of the hair. Despite having temperature sensors to prevent overheating hair, the user still needs to blow dry in specific ways to achieve a particular style.

[0006] Known hair dryers do not provide any assistance to a user in achieving an optimum drying pattern, or in achieving their desired style. More generally, known hair care devices do not provide assistance to provide an optimum delivery of heat for the hair care routine.

SUMMARY OF THE INVENTION

[0007] The invention is defined by the claims.

[0008] According to examples in accordance with an aspect of the invention, there is provided a hair care system, comprising:

- a heater;
- a temperature control system for controlling the heater;
- a temperature sensor for detecting a hair temperature at least at a location where heat is delivered to the hair by the heater; and
- a processing system, configured to:

- in use of the hair care system, create a map of hair temperature;
- obtain a target temperature map;
- based on the map of hair temperature and the target temperature map, determine an amount of heating needed to separate locations of the

hair;

generate an output to guide a user to provide said determined amount of heating to said separate locations.

[0009] The invention provides a hair care system (e.g., hair dryer) that uses temperature sensing to reconstruct a (3D) map of the hair temperature. This map is used to guide a user to heat places on the head, and hence areas of hair, that require heating as part of the hair care routine being performed, e.g., blow drying.

[0010] In a most basic implementation, there is a single target temperature map representing a desired general heat distribution. However, as explained below, the target temperature map may be tailored to the individual, such as depending on their hair type and hair style.

[0011] The separate locations are for example general segments of the hair, such as top, back, each side and longer hair. Alternatively, the separate locations may have a finer resolution.

[0012] A comparison is made between the target temperature map and the current temperature map. The difference can then be iteratively minimized by instructing the user to apply more or less heating (e.g., blow drying) to a particular area.

[0013] The output may be an audio or video message presented to the user by the user's hair care device (e.g., hair dryer), or it may be a communication to an external device (such as a smartphone) which then provides the guidance to the user. Thus, the "hair care system" may simply be a user's hair care device such as a hair dryer, or it may be the combination of a user hair care device and one or more external devices. In such cases, the "processing system" may comprise multiple processing units, one in the user's device (e.g., hair dryer) and one or more external processing units.

[0014] The user device may for example simply transmit the temperature sensing information to a remote processing unit (again for example a smartphone) which performs the data processing. Processing may however also or instead be performed even more remotely by communication with a server over the internet.

[0015] The hair care system may further comprise a motion sensor for sensing motion of the location where heat is delivered, namely by sensing motion of the user device, e.g., the hair dryer.

[0016] The motion sensing enables the location of the user device and preferably also the direction in which it is facing to be derived, so it can be determined (or estimated) which hair location is being heated.

[0017] The motion sensor for example comprises an inertial measurement unit (IMU). This can determine the hair location and in some examples it can also be used to determine the direction with which heat is delivered to the hair (e.g., the direction of heated air flow). The guidance to a user may then be more detailed than simply indicating a hair location. For example, it may include a direction of application of heat.

[0018] In one example, the temperature sensor is for sensing a single temperature. A map of temperature is then built up over time as the user moves the hair dryer around the head.

[0019] In another example, the temperature sensor comprises a thermal camera. This may create a thermal image of the head of the user. A thermal camera can be used to function both as a temperature sensor and as a position/orientation sensor, hence avoiding the need for motion sensing (or it may be combined with motion sensing). The orientation and position can be derived from stable landmarks in the thermal image.

[0020] The processing system is for example configured to control the temperature control system automatically in dependence on the location to which heat is delivered. Thus, the temperature setting may be adjusted automatically as the user device is moved to different hair locations.

[0021] In one set of examples, the hair care system comprises a hair drying system, wherein the heater is for heating air and the system further comprises a fan for directing the heated air to the hair thereby to deliver the heat to the hair. Thus, the "user's device" mentioned above is a hair dryer.

[0022] The hair drying system may further comprise a fan speed control system, and the processing system may (also or instead) be configured to control the fan speed control system automatically in dependence on the location to which heated air is directed. Thus, the fan speed setting may be adjusted automatically as the hair dryer is moved to different hair locations.

[0023] The processing system is for example configured to access a database of hair styles each with a corresponding target temperature map, and to determine an amount of heating needed to separate locations of the hair to achieve the target temperature map for a selected hair style.

[0024] Thus, the guidance to the user takes account of the desired hair style. As mentioned above, the hair dryer itself can adjust the temperature to minimize the difference between the target temperature map and the current temperature map, or else the user can be guided to do this manually. The result is a hair style or look that resembles the target hair style that was chosen from the database.

[0025] The target temperature map for example comprises a set of temperature distributions over time. This enables the guidance to have more detail to achieve better outcomes. The desired heating may for example change when the hair is nearly dry.

[0026] The hair drying system may further comprise the database of hair styles. Again, this database is typically remote from the hair dryer, and is thus part of an external device, for example a remote server accessed via the cloud.

[0027] The database of hair styles for example defines, for each hair style, a set of target temperature maps for one or more of:

different skin type;
different hair color;
different hair type

[0028] The target temperature map may thus depend on the style, and also the type of hair, such as curly, straight, thin, thick etc. The database of hair styles for example defines, for each hair style, a set of temperature distributions over time.

[0029] The invention also provides a hair care method, comprising:

obtaining a target temperature map; and
while hair care is being carried out:

detecting a hair temperature at least at a location where heat is delivered to the hair;
creating a map of hair temperature;
based on the map of hair temperature and the target temperature map, determining an amount of heating needed to separate locations of the hair; and
generating an output to guide a user to provide said determined amount of heating to said separate locations.

[0030] The method for example comprises:

accessing a database of hair styles each with a corresponding target temperature map thereby to obtain the target temperature map; and
determining an amount of heating needed to separate locations of the hair to achieve the target temperature map for a selected hair style.

[0031] The invention also provides a computer program comprising computer program code which is adapted, when said program is run on a computer, to implement the method defined above.

[0032] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] For a better understanding of the invention, and to show more clearly how it may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, in which:

Fig. 1 shows a hair care system; and
Fig.2 shows a care method.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0034] The invention will be described with reference to the Figures.

[0035] It should be understood that the detailed de-

scription and specific examples, while indicating exemplary embodiments of the apparatus, systems and methods, are intended for purposes of illustration only and are not intended to limit the scope of the invention. These and other features, aspects, and advantages of the apparatus, systems and methods of the present invention will become better understood from the following description, appended claims, and accompanying drawings. It should be understood that the Figures are merely schematic and are not drawn to scale. It should also be understood that the same reference numerals are used throughout the Figures to indicate the same or similar parts.

[0036] The invention provides a hair care system which uses a temperature sensor to create a map of hair temperature. This temperature map is processed together with a target temperature map to determine an amount of heating needed to separate locations of the hair. An output is generated to guide a user to provide the required determined amount of heating to those separate hair locations.

[0037] The hair care system performs various data processing functions, and these functions may be distributed in different ways between a user's hand-held hair care device such as a hair dryer and one or more external devices such as a user's smartphone and/or an external processor of the hair dryer manufacturer.

[0038] Fig. 1 shows one example implementation of a hair care system 10, comprising a hair dryer 20 (a blow dryer), a user's smartphone 30 and an external database 40.

[0039] The invention is thus described below with reference to an implementation of a hair dryer. However, the invention may be applied to any hair care device which applies heat to different regions of the hair as part of a hair care routine. Examples include hair curling (using heated hair curling tongs) and hair straightening (using heated hair straighteners).

[0040] As shown in more detail in the enlarged view of the hair dryer 20, the hair dryer comprises a heater 22 for heating air and a fan 24 for directing the heated air to the hair. The heater is for example a resistive heater. However, an IR heater may instead be used, and this may avoid the need for generation of an airflow. Furthermore, other hair care devices as mentioned above may apply heat directly to the hair rather than generating remote heating, e.g., using a heated air flow to deliver the heat to the hair. A temperature control system 23 is provided for controlling the heater. This may be a controller which is manually operated by the user, or it may be controlled in an automated way, or both. For a device with a fan, such as the blow dryer of this example, a fan speed control system 25 is provided for controlling the fan speed. This again may be a controller which is manually operated by the user, or it may be controlled in an automated way, or both.

[0041] A temperature sensor 26 is provided for detecting a hair temperature at least at a location where heated air is directed to the hair.

[0042] The temperature sensor in a preferred example is a thermal camera, which provides a map of the temperature over a larger area of the head (the part of the head currently facing the camera and hence in the field of view of the camera). However, a simple implementation can use a sensor for measuring a temperature at one location. This could be a (deep) IR sensor.

[0043] A processing system is provided for creating a map of hair temperature during use of the hair dryer. This is a 3D map of the scalp. For this purpose, the system needs to know the hair location corresponding to a temperature measurement. Thus, the location and orientation of the hair dryer needs to be known relative to the user's head.

[0044] As discussed more fully below, this may be achieved using the thermal camera. However, Fig. 1 shows an alternative (or additional) option of a motion sensor in the form of an inertial measurement unit 29. It can track the movement (and hence position) of the hair dryer as well as the orientation.

[0045] The position and orientation relative to the user's head (rather than relative to free space) may be determined by using a calibration procedure. A basic calibration procedure for example may involve orienting the hair dryer to a predefined feature such as the forehead.

[0046] For a basic embodiment (for example with a single pixel thermal sensor so that image analysis is not possible), a calibration procedure may be used which involves a sequence of movements. A smartphone is for example used to guide the user to apply the hair dryer to a sequence of hairstyle segments in one or more calibrating blow drying routines. During this guided use of the hair dryer, IMU readings are logged over time. Assuming the user follows the guidance, accumulated and further analyzed IMU data statistics can be used to build models for giving user real-time feedback, for example with respect to how to change the movement of the hair dryer in order to achieve a uniform temperature distribution over the hairstyle segment being currently treated.

[0047] One way to obtain the device location and orientation relative to the user is to track both the device (e.g., using an IMU) and to track the movement of the user's head (e.g., using camera images from a smartphone capturing images of the user or using the same thermal camera used to capture the heat map, as described further below).

[0048] In all cases, a target temperature map is obtained, in this example from the external database 40. Based on the map of hair temperature and the target temperature map, an amount of heating needed is derived for separate locations of the hair.

[0049] A most basic version only has one target temperature map, representing a desired general hair drying profile, hence a database is not essential. However, the use of a database enables different hair styles to be considered, with associated (3D) temperature maps required to achieve a desired look for varying styles, colors,

and types of hair (for example depending on skin type, hair color, and hair type such as straight, curly, hair thickness, etc.).

[0050] An output is then generated to guide a user to provide said determined amount of heating to said separate locations. In particular, the guidance to the user is to instruct the user to move the hair dryer to a particular location. The output in this example is delivered by the smartphone 30 (via the display and/or speaker). Augmented reality or virtual reality techniques may be used.

[0051] The processing system in this example of system configuration comprises the combination of a first processing unit 28 of the hair dryer and a second processing unit 32 of the smartphone.

[0052] The hair dryer has a wireless communication system (transceiver) for communicating with the smartphone in this example, for example using Bluetooth, or a Wi-Fi connection, or other short-range communications system.

[0053] In this example, the smartphone provides the access to the database and also performs the computation of the difference between the target temperature map and the current temperature map, and thereby derives the suitable guidance for the user to apply the hair dryer to specific areas of the hair.

[0054] The smartphone may also create the temperature map, so that the hair dryer only needs to send the measured temperature and location information. As mentioned above, the location information may be embedded in the temperature information.

[0055] As mentioned above, the map of the current hair temperature is compared to the target temperature map that has been chosen from the database by the user. The comparison may use statistical or artificial intelligence (i.e., machine learning) techniques to find the areas of the current temperature that need heating to arrive at the target temperature map.

[0056] Instead of a single target temperature map, the map may evolve over time so that there is a continuous comparison of a varying target temperature map and the current temperature map.

[0057] In one example, the system configures the hair dryer to change the temperature (and possibly fan speed) to safely and efficiently minimize the difference between the target temperature map and the current temperature map. The control may for example ensure the hair dryer does not deliver air to the face with too high temperature and/or fan speed. By minimizing the differences between the current and target temperature maps, the hair style of the user will resemble as closely as possible the target hair style.

[0058] When the temperature map evolves over time, it can be expressed as a (continuous) series of steps over time to achieve the target hair style. This is shown schematically in Fig. 1, wherein three target temperature maps are illustrated corresponding to a single hair style but at different stages of the drying process. A simpler database implementation will have a single target tem-

perature map over time (per hair style and optionally per hair type). Having a series of intermediate steps instead of a single target enables guidance to be provided with higher levels of detail and possibly even better outcomes. A final detailing of a hair style may for example be achieved when the hair is nearly dry.

[0059] The guidance may be on a segment-by-segment perspective of the hair style. For example, the smartphone may guide the user to, for example, first blow dry the top of the head until the difference between the target and current temperature maps is sufficiently small. Then as the next segment, for example, the sides are addressed. Next, the user is guided towards the back, and finally towards the longer parts of the hair towards the neck and shoulders. However, the locations may be finer, hence with more separate locations.

[0060] If the hair dryer is fitted with motion sensing, such as using an IMU, the orientation of the hair dryer can be calculated in space and it can be determined how it is angled towards the hair using a coordinate system. This information can then be used to guide the user in a more free-form way where the system follows where the user is drying their hair and adjusts the guidance dynamically to those areas that need to have further drying.

[0061] IMU data for example enables registering the speed and "intensity" of the movement of the blow dryer so that these may be compared to ideal IMU data for a target temperature map. For instance, optimization may be to create a strong swooping/waving motion for curls of multiple folds, or slow gentle waving to be gentle with weak hair types etc.

[0062] As mentioned above, the location sensing, to enable the map to be created, may be achieved by the thermal camera images. Different colors in a thermal camera image indicate different temperatures. By providing a full thermal camera in the hair dryer instead of only a single pixel sensor, the captured full thermal image of the head (within the field of view) enables location as well as orientation tracking by using automatic detection of stable landmarks in the thermal image. This can be used to support or even replace the orientation and location calculations from a motion sensor, such as IMU data.

[0063] For example, facial features will be present in thermal image when using the hair dryer in front of the user. This enables a full range of image processing techniques based on feature recognition to enable location and orientation detection (relative to the user's head). By mounting the thermal camera on the hair dryer itself, the thermal camera and the hair dryer are brought into a single coordinate system. This can be combined with onboard (or onboard of the smartphone) computer vision, to allow determination of the exact temperature of the hair relative to a landmark (e.g., the person's face). This temperature information in turn can be used to guide the user to redirect the hair dryer output nozzle to the right part of the hair style at the right moment.

[0064] By combining thermal imaging with motion sen-

sing, the motion sensing can extrapolate/interpolate between time points when feature recognition is effective, to cover time points when feature recognition is not effective.

[0065] Another option is to use the smartphone (or a tablet) with a thermal camera to function as mirror while hair drying. A thermal image, with suitable color to temperature reference scale, can enable the system to visualize a temperature map around the head to the user, providing user with a very intuitive way of showing where temperature needs to be changed.

[0066] Fig. 2 shows a hair care method.

[0067] In step 50, a target temperature map is received. This step for example involves accessing a database of hair styles each with a corresponding target temperature map.

[0068] In step 52, a hair temperature is detected while hair care, e.g., hair drying, is being carried out, at least at a location where heat is delivered to the hair, e.g., where heated air is directed to the hair.

[0069] In step 54 a map of current hair temperature is formed.

[0070] In step 56, based on the map of current hair temperature and the target temperature map, an amount of heating needed to separate locations of the hair is determined (in some example to achieve the target temperature map for a selected hair style).

[0071] In step 58, an output is provided to guide a user to provide the required amount of heating to the different hair locations.

[0072] In the example above, there is a remote database. In another example, the database can be stored locally in the smartphone or even in the hair dryer.

[0073] In the example above, some of the processing is in the smartphone. However, the smartphone may only act as gateway to an online (cloud) service that does the computations (as well as storing the database) and relays them back to the smartphone.

[0074] Variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

[0075] Functions implemented by a processor may be implemented by a single processor or by multiple separate processing units which may together be considered to constitute a "processor". Such processing units may in some cases be remote from each other and communicate with each other in a wired or wireless manner.

[0076] The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0077] A computer program may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part

of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems.

[0078] If the term "adapted to" is used in the claims or description, it is noted the term "adapted to" is intended to be equivalent to the term "configured to". If the term "arrangement" is used in the claims or description, it is noted the term "arrangement" is intended to be equivalent to the term "system", and vice versa.

[0079] Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A hair care system (10), comprising:

a heater (22);
a temperature control system (23) for controlling the heater;
a temperature sensor (26) for detecting a hair temperature at least at a location where heat is delivered to the hair by the heater; and
a processing system (28, 32), configured to:

in use of the hair care system, create a map of hair temperature;
obtain a target temperature map;
based on the map of hair temperature and the target temperature map, determine an amount of heating needed to separate locations of the hair;
generate an output to guide a user to provide said determined amount of heating to said separate locations.

2. The hair care system of claim 1, further comprising a motion sensor (29) for sensing motion of the location where heat is delivered.

3. The hair care system of any one of claims 1 to 2, wherein the temperature sensor (26) is for sensing a single temperature.

4. The hair care system of any one of claims 1 to 2, wherein temperature sensor (26) comprises a thermal camera.

5. The hair care system of any one of claims 1 to 4, wherein the processing system (28, 32) is configured to control the temperature control system automatically in dependence on the location to which heat is delivered.

6. The hair care system of any one of claims 1 to 5 comprising a hair drying system, wherein the heater (22) is for heating air and the system further comprises a fan (24) for directing the heated air to the hair

thereby to deliver the heat to the hair.

7. The hair drying system of claim 6, comprising a fan speed control system (25), wherein the processing system is configured to control the fan speed control system (25) automatically in dependence on the location to which heated air is directed. 5

8. The hair drying system of any one of claims 6 to 7, wherein the processing system (28, 32) is configured to: 10

access a database (40) of hair styles each with a corresponding target temperature map; and determine an amount of heating needed to separate locations of the hair to achieve the target temperature map for a selected hair style. 15

9. The hair drying system of claim 8, wherein the target temperature map comprises a set of temperature distributions over time. 20

10. The hair drying system of claim 8 or 9, further comprising the database (40) of hair styles. 25

11. The hair drying system of claim 10, wherein the database (40) of hair styles defines, for each hair style, a set of target temperature maps for one or more of: 30

different skin type;
different hair color;
different hair type.

12. The hair drying system of claim 11, wherein the database (40) of hair styles defines, for each hair style, a set of temperature distributions over time. 35

13. A hair care method, comprising: 40
(50) obtaining a target temperature map; and while hair care is being carried out:

(52) detecting a hair temperature at least at a location where heat is delivered to the hair; 45
(54) creating a map of hair temperature;
(56) based on the map of hair temperature and the target temperature map, determining an amount of heating needed to separate locations of the hair; and 50
(58) generating an output to guide a user to provide said determined amount of heating to said separate locations. 55

14. The hair care method of claim 13, comprising:

accessing a database of hair styles each with a

corresponding target temperature map thereby to obtain the target temperature map; and determining an amount of heating needed to separate locations of the hair to achieve the target temperature map for a selected hair style.

15. A computer program comprising computer program code which is adapted, when said program is run on a computer, to implement the method of claim 13 or 14.

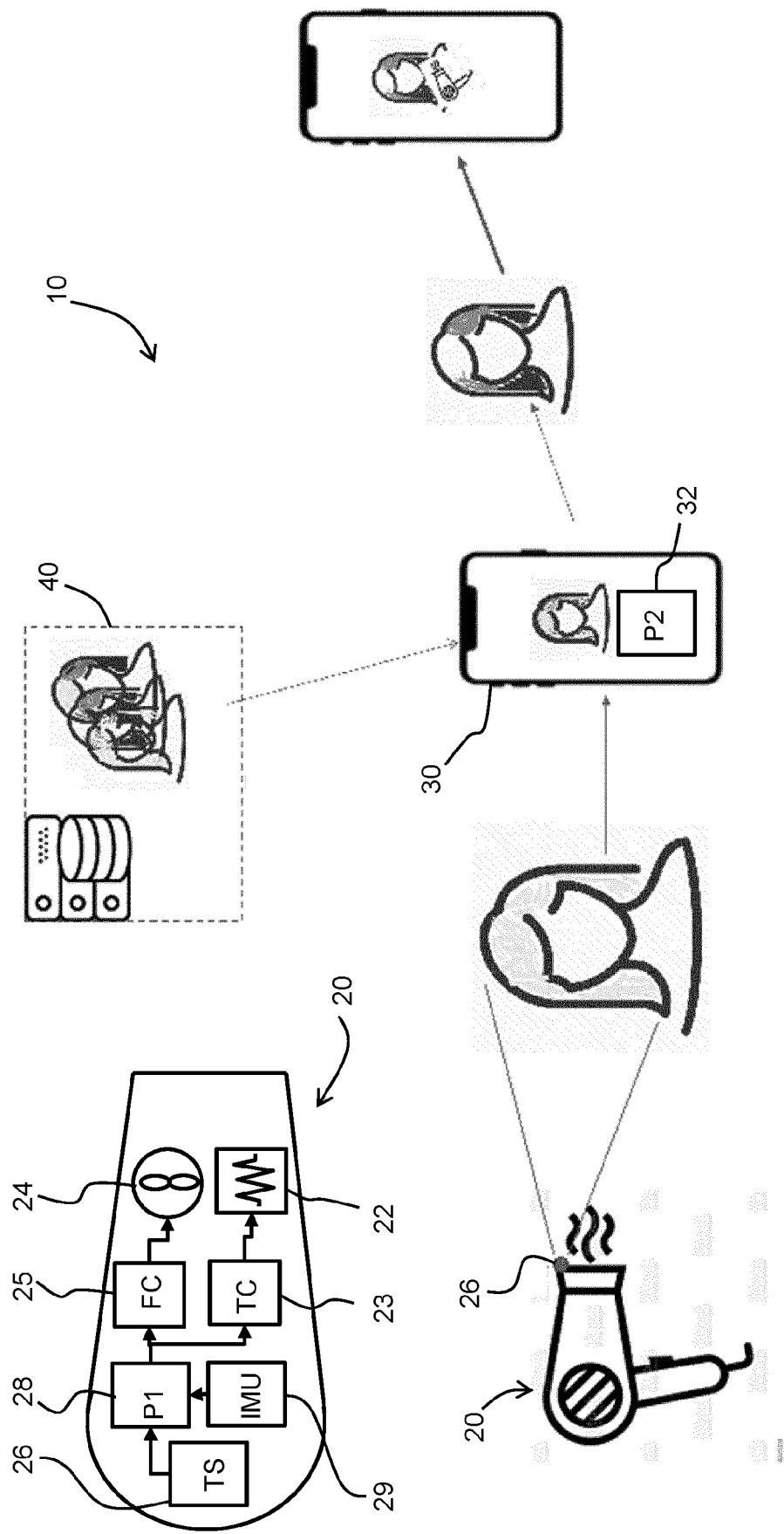


FIG. 1

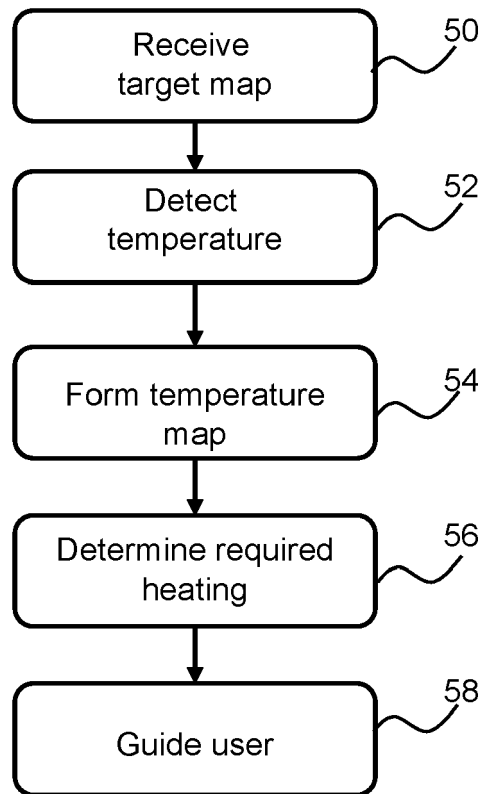


FIG. 2



EUROPEAN SEARCH REPORT

Application Number

EP 23 18 1379

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 834 540 A1 (GANDOLFO GIOVANNI [IT]) 19 September 2007 (2007-09-19)	1, 3-7, 13-15	INV. A45D1/28
Y	* abstract * * page 6, line 30 - line 48 * * page 7, line 48 - page 8, line 4 * * page 11, line 29 - line 56 * * page 15, line 20 - line 24 * * figures 8, 10 * * claims 18, 19 *	2	A45D20/12 ADD. A45D44/00
Y	US 2022/007809 A1 (WANG MINGYU [CN] ET AL) 13 January 2022 (2022-01-13) * paragraph [0096] *	2	
			TECHNICAL FIELDS SEARCHED (IPC)
			A45D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		11 December 2023	Zetzsche, Brigitta
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 23 18 1379

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82