US 20220160096A1

(19) United States
(12) Patent Application Publication
Harrison et al.
(10) Pub. No.: US 2022/0160096 A1
(43) Pub. Date: May 26, 2022

(54) APPARATUS AND METHOD FOR DRYING AND STYLING HAIR

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(21) Appl. No.: **17/597,643**

(22) PCT Filed: **Jul. 29, 2020**

(86) PCT No.: **PCT/GB2020/051818**

§ 371 (c)(1),
(2) Date: **Jan. 14, 2022**

(30) **Foreign Application Priority Data**

Jul. 30, 2019 (GB) 1910869.5

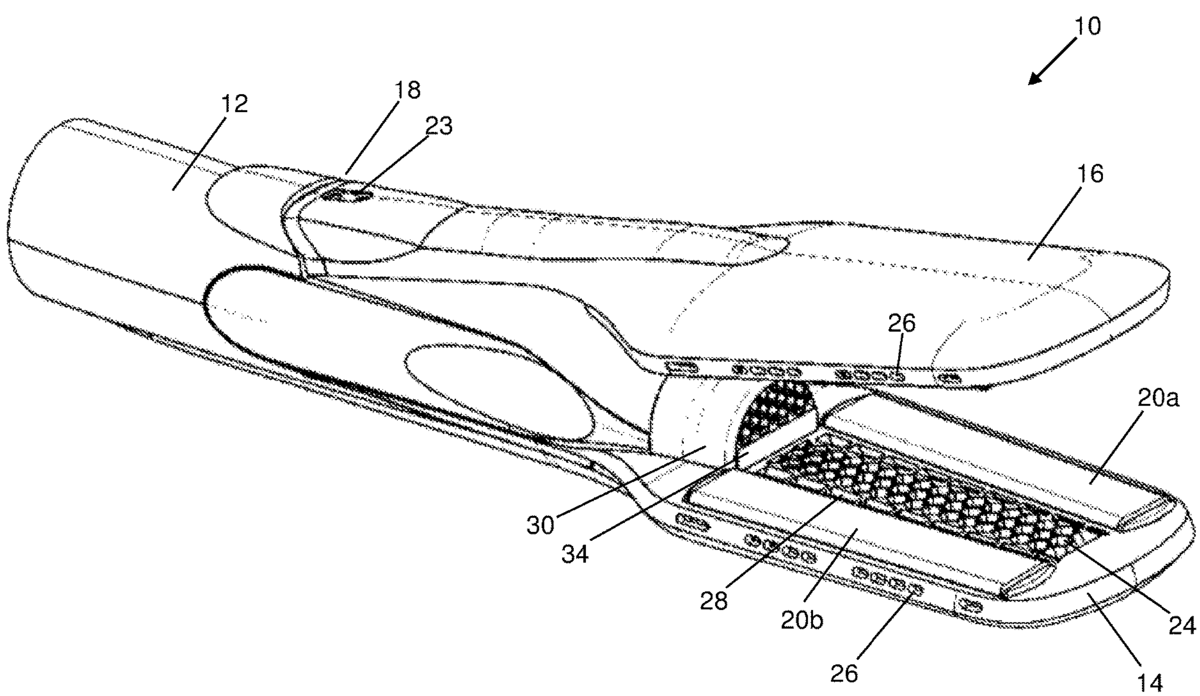
Publication Classification

(51) **Int. Cl.**
A45D 20/12 (2006.01)
A45D 2/00 (2006.01)
A45D 7/02 (2006.01)

(52) **U.S. Cl.**
CPC *A45D 20/12* (2013.01); *A45D 7/02* (2013.01); *A45D 2/001* (2013.01)

(57) **ABSTRACT**

Apparatus for drying and styling hair, comprising: first and second mutually-opposing arms adapted for movement between an open configuration for receiving a length of wet hair therebetween and a closed configuration adjacent the hair, such that, in use, when the arms are in the closed configuration they form an inter-arm chamber across which the hair passes, and wherein an airflow conduit is provided within and along at least one of the first and second arms; and means for delivering a flow of air along the conduit in the at least one of the first and second arms, and subsequently into the inter-arm chamber. Also provided is a method of drying (and optionally simultaneously styling) hair using such apparatus.



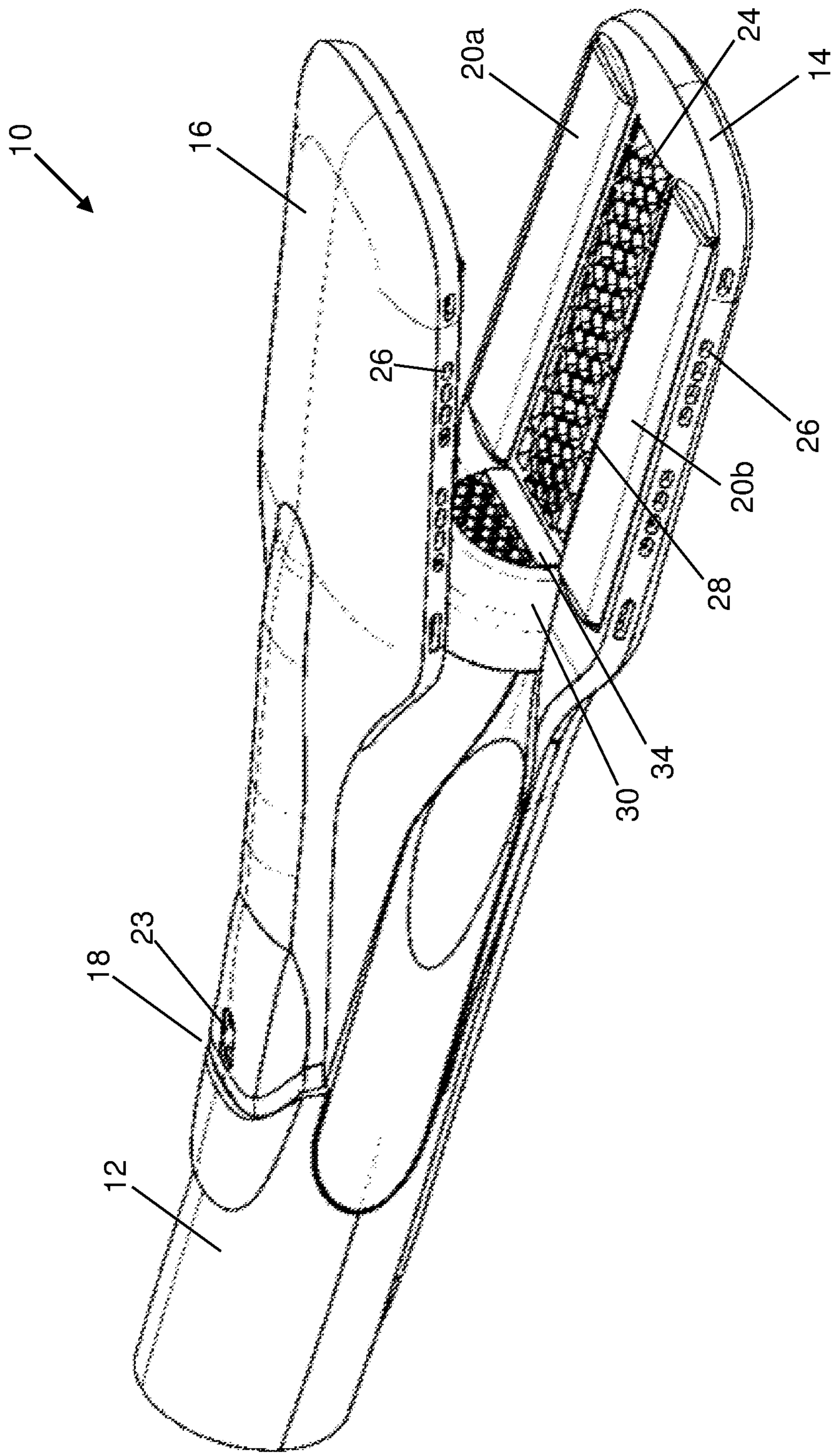
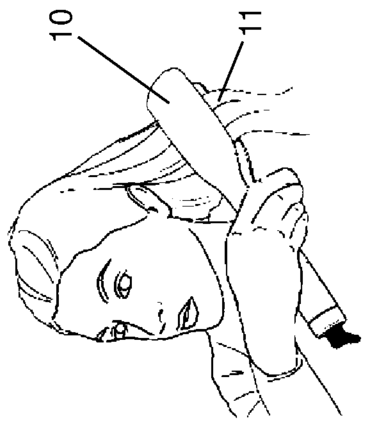


Figure 1



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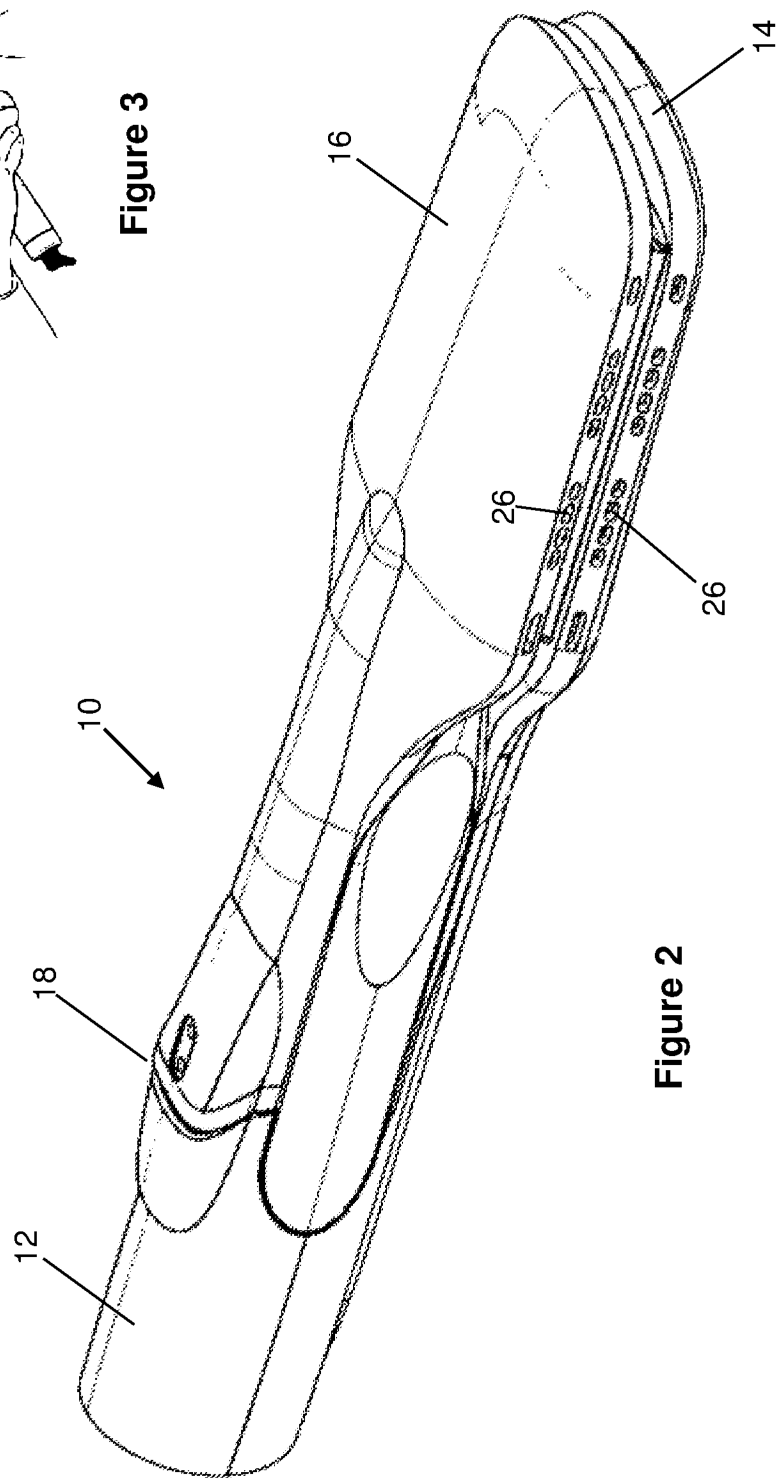

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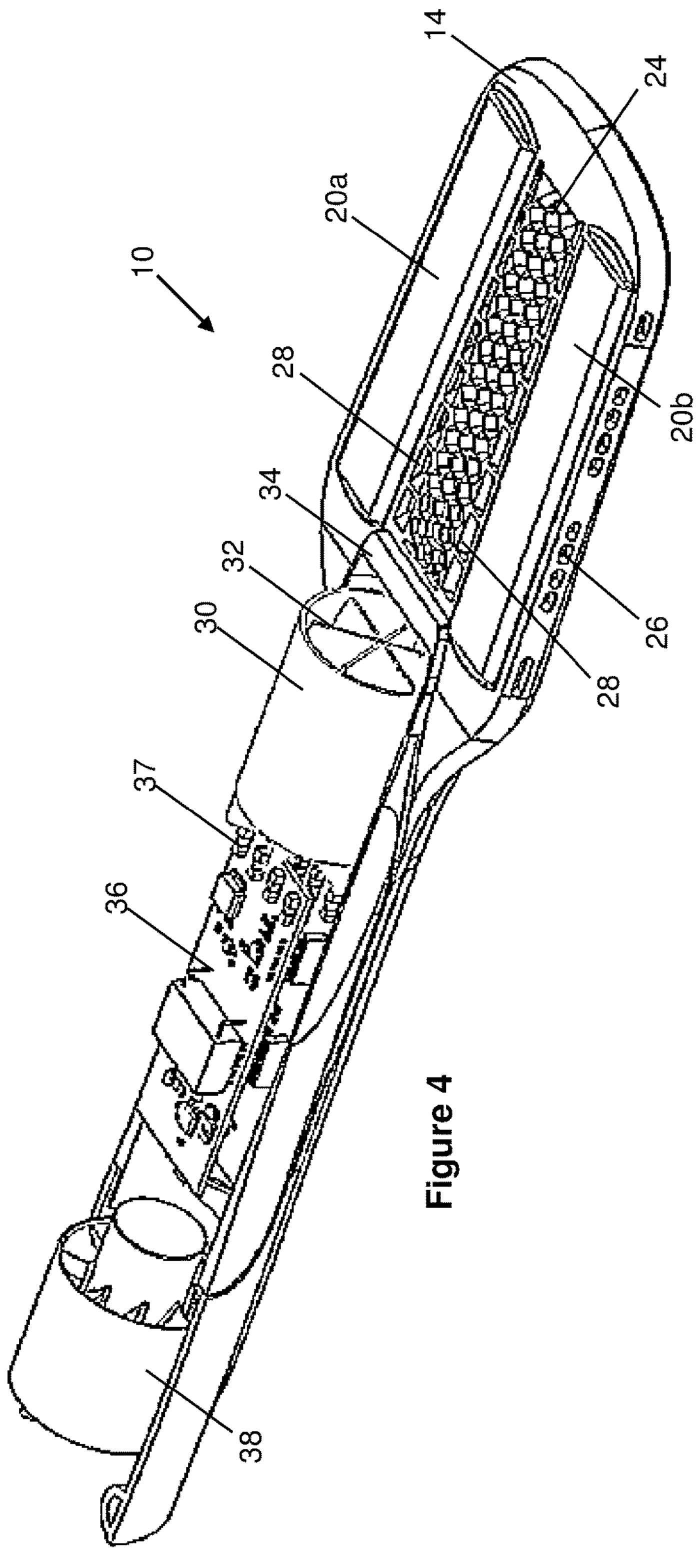

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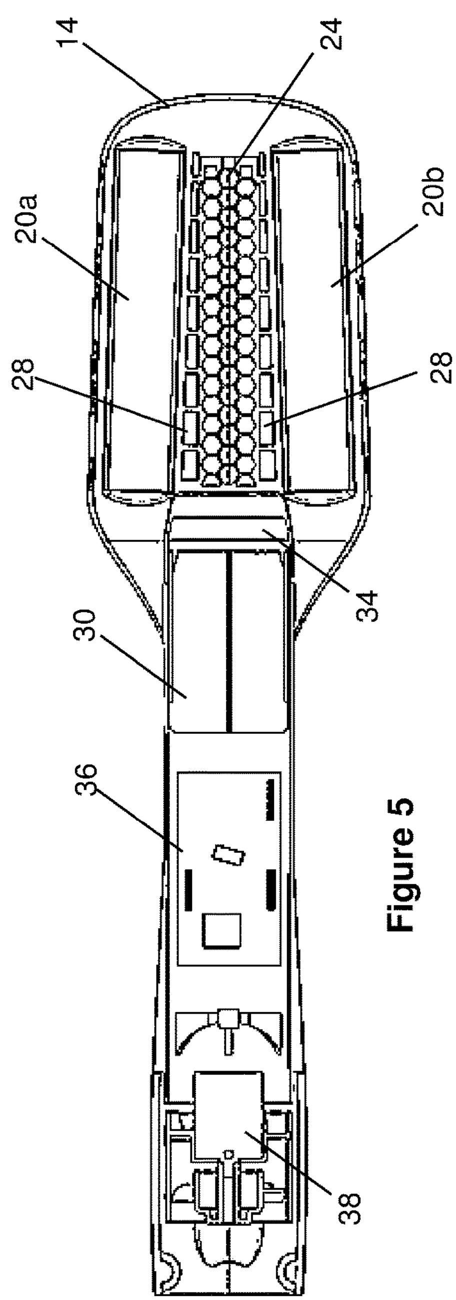

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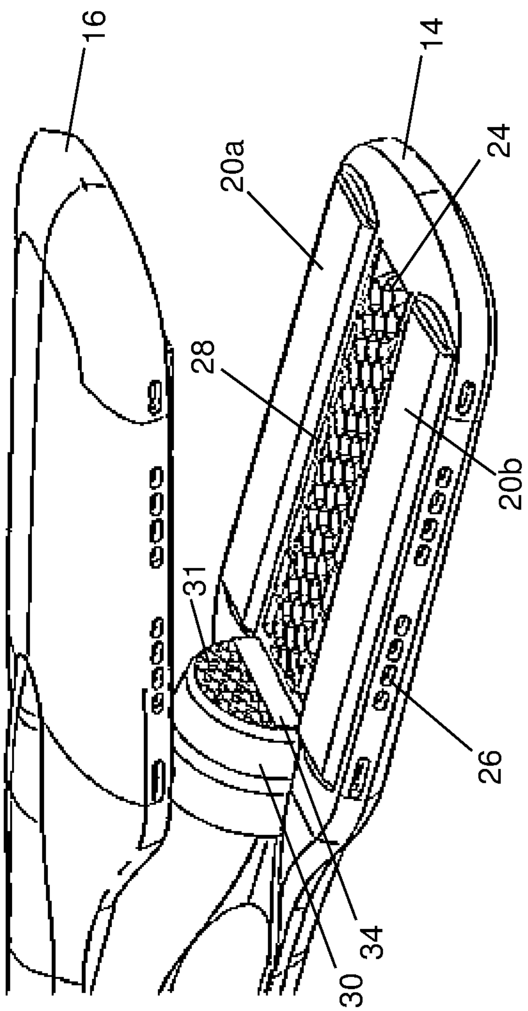

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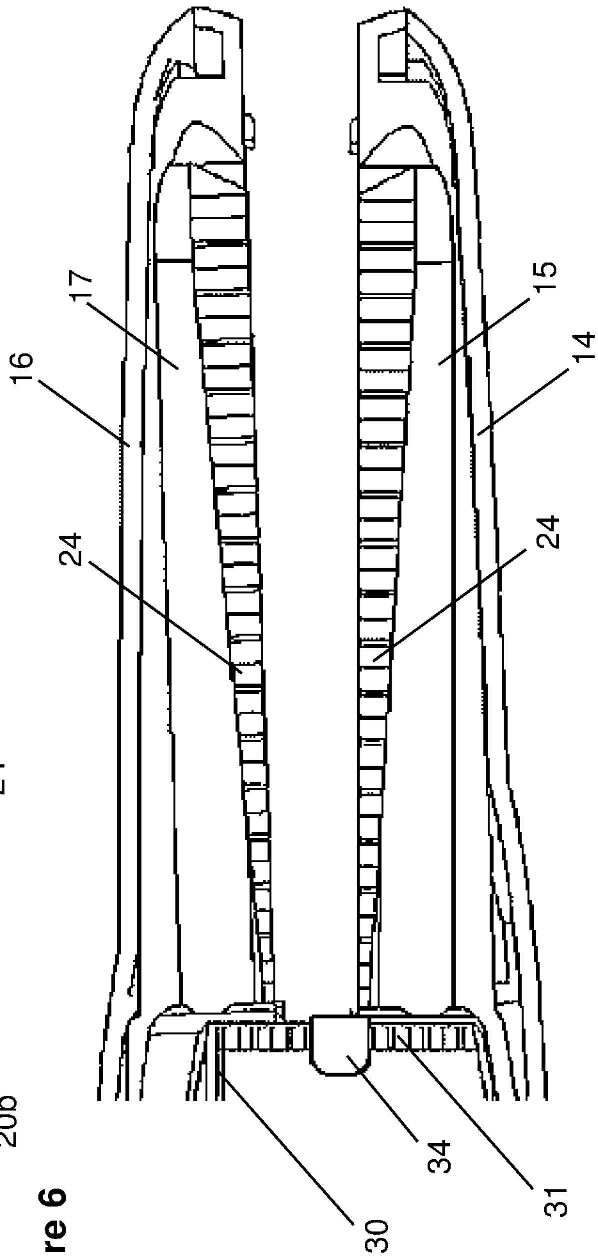

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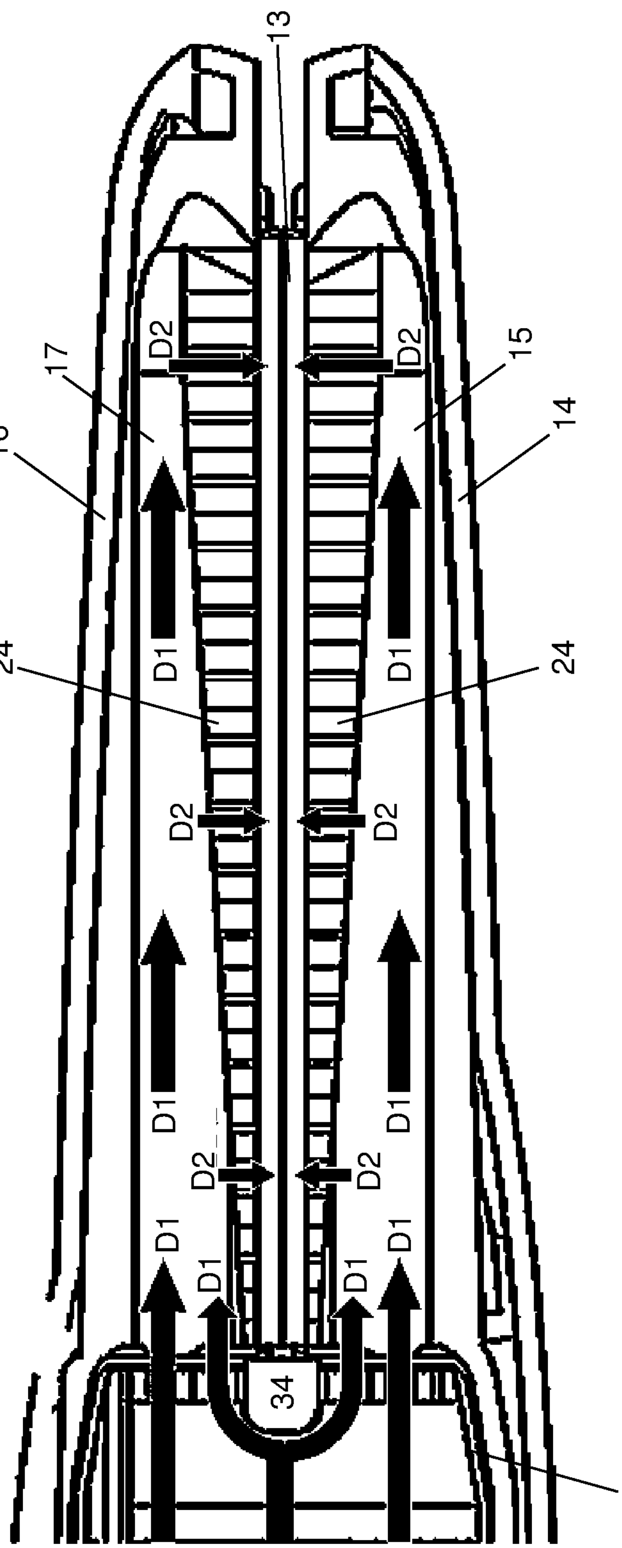

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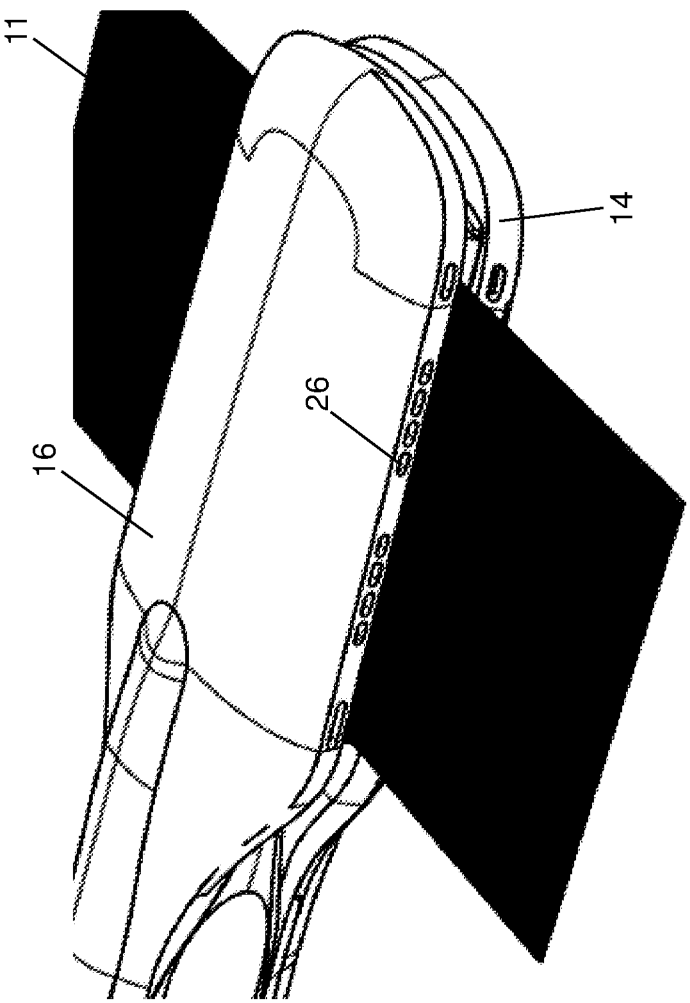

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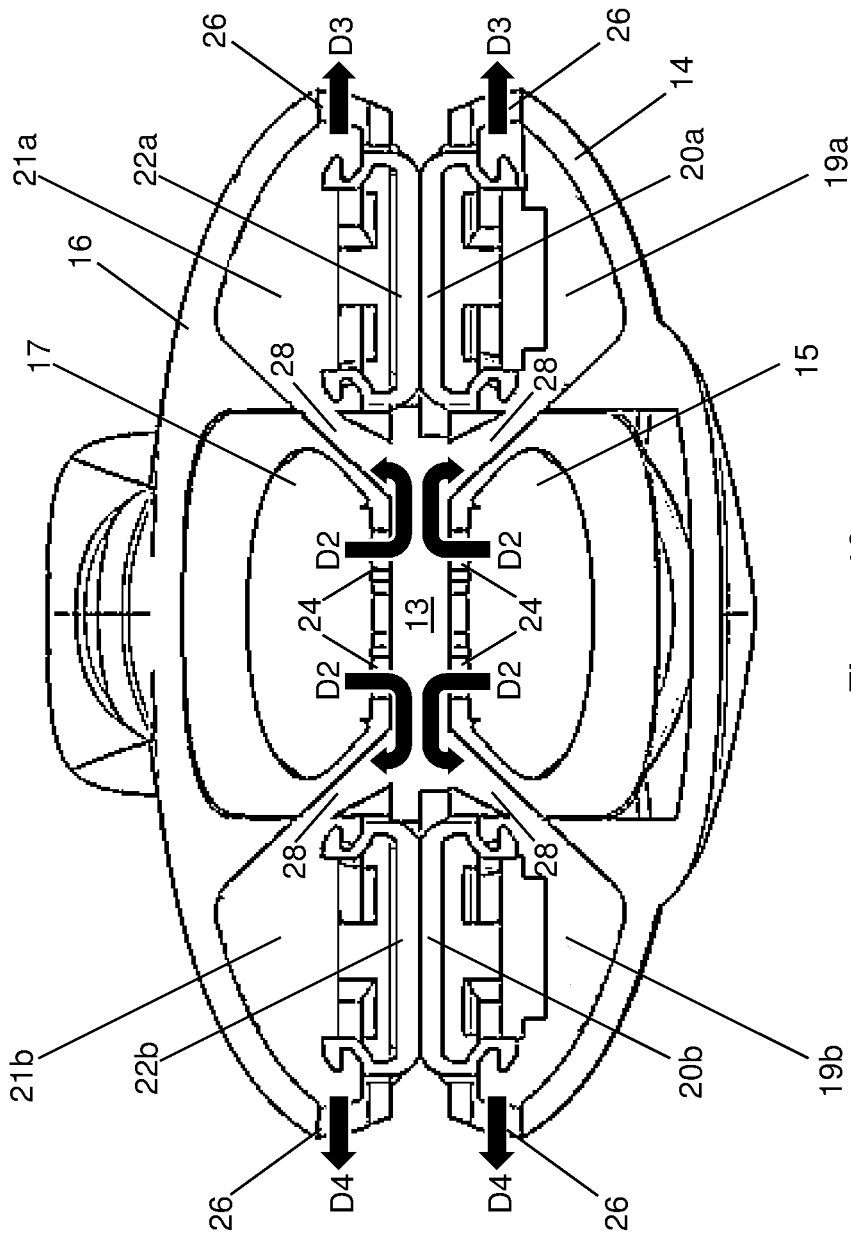
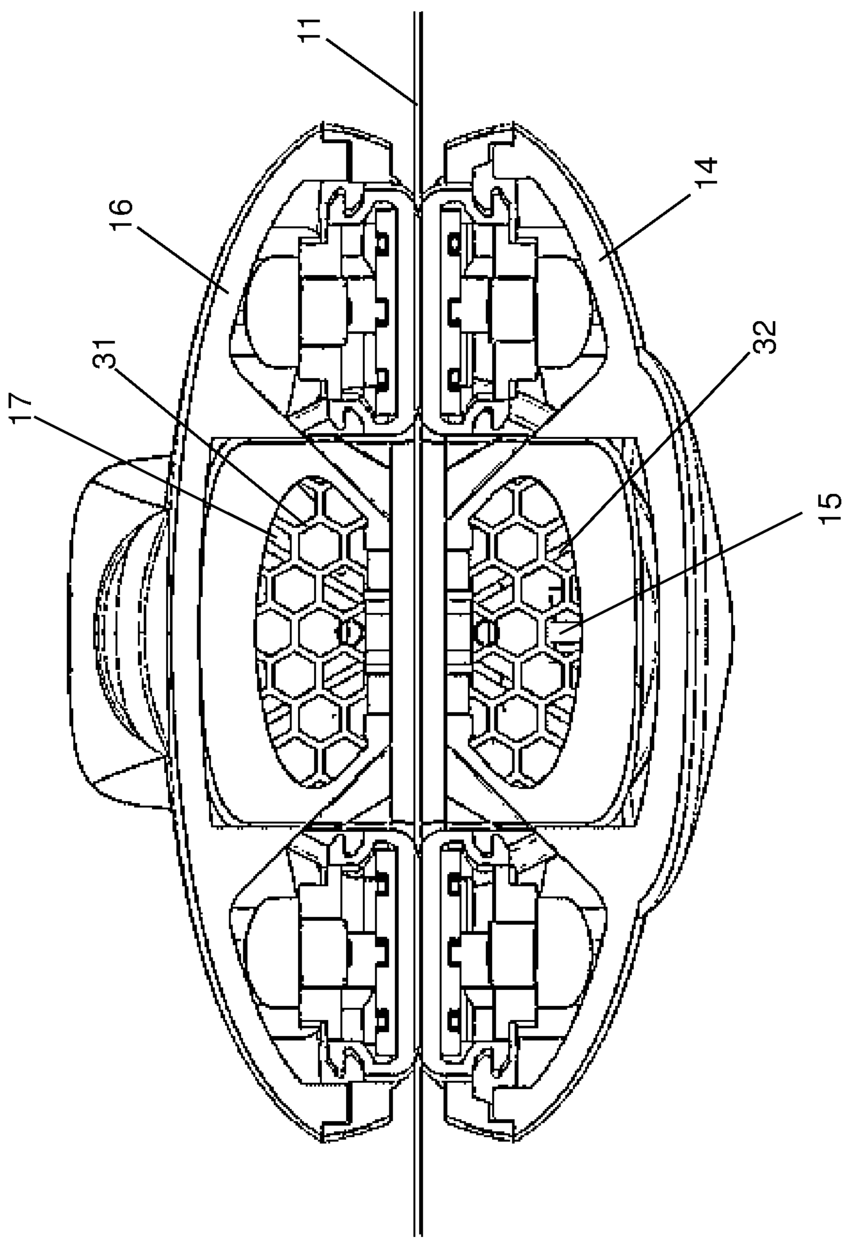

26
D3
D3
26
14
21a
22a
20a
19a
16
17
28
28
15
D2
D2
24
13
24
D2
D2
28
28
21b
22b
20b
19b
26
D4
D4
26

Figure 10



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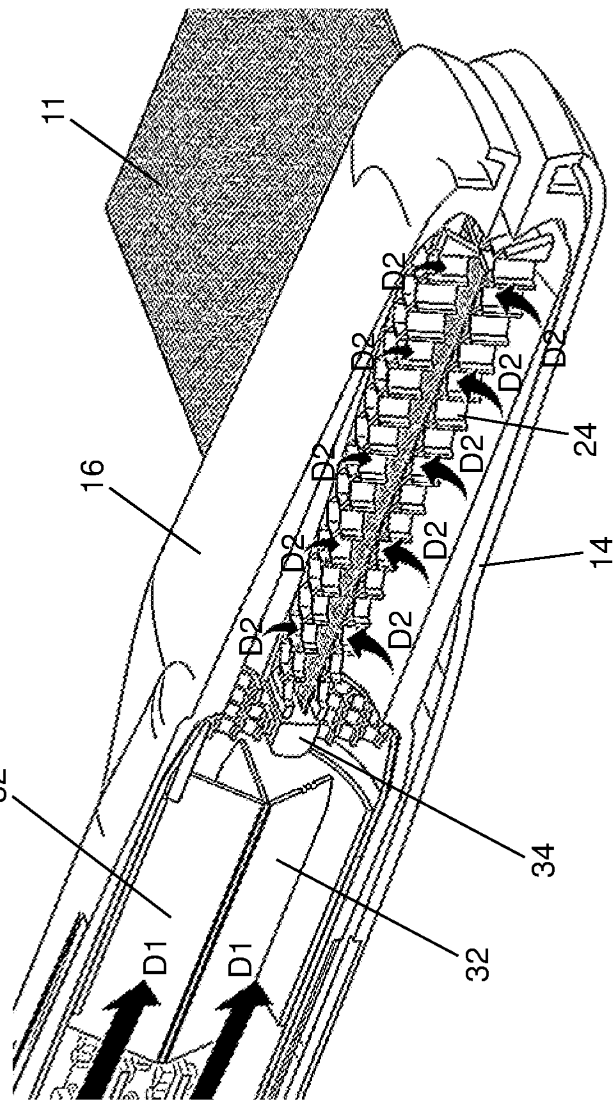

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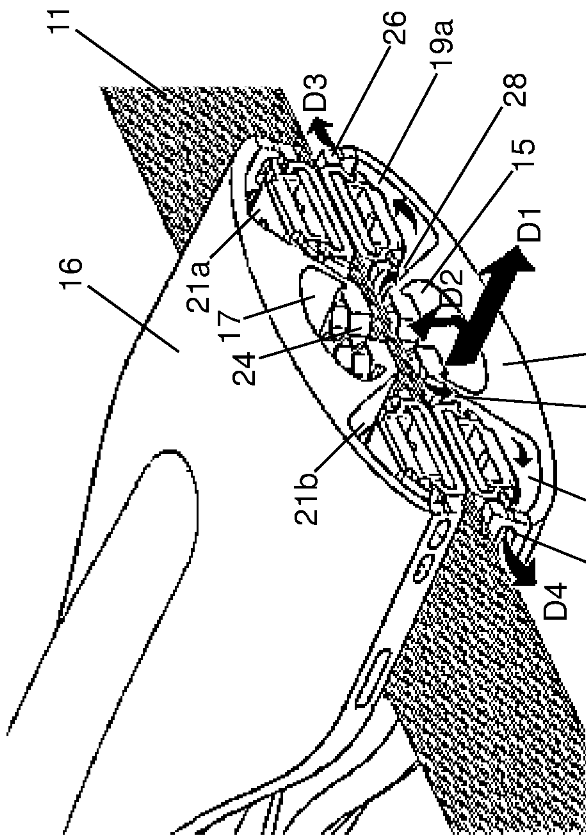

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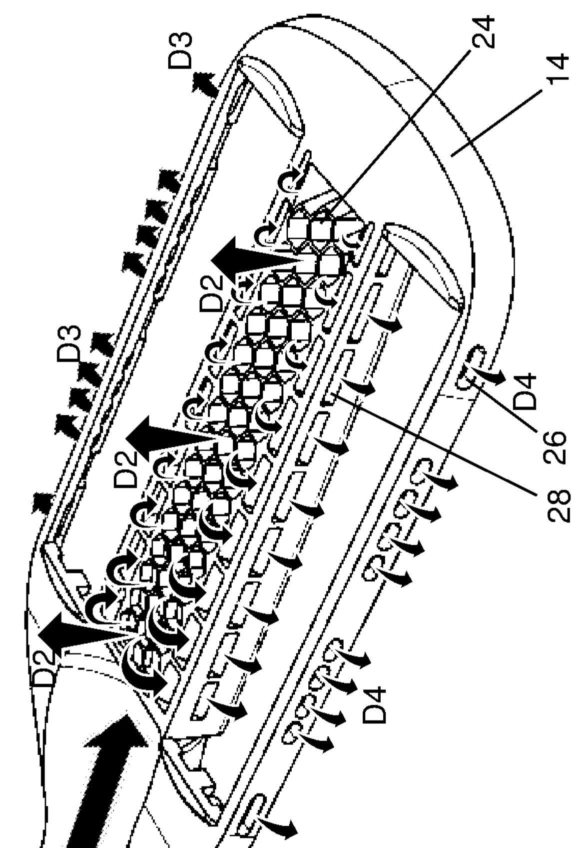

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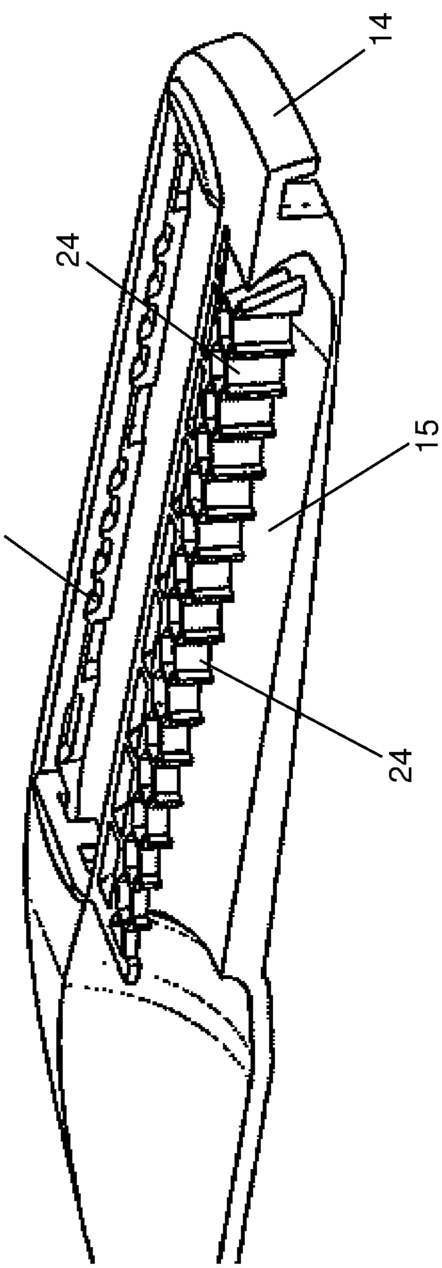

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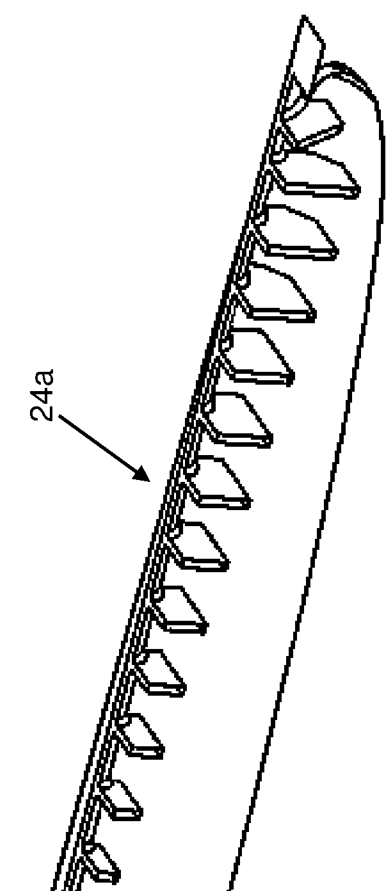

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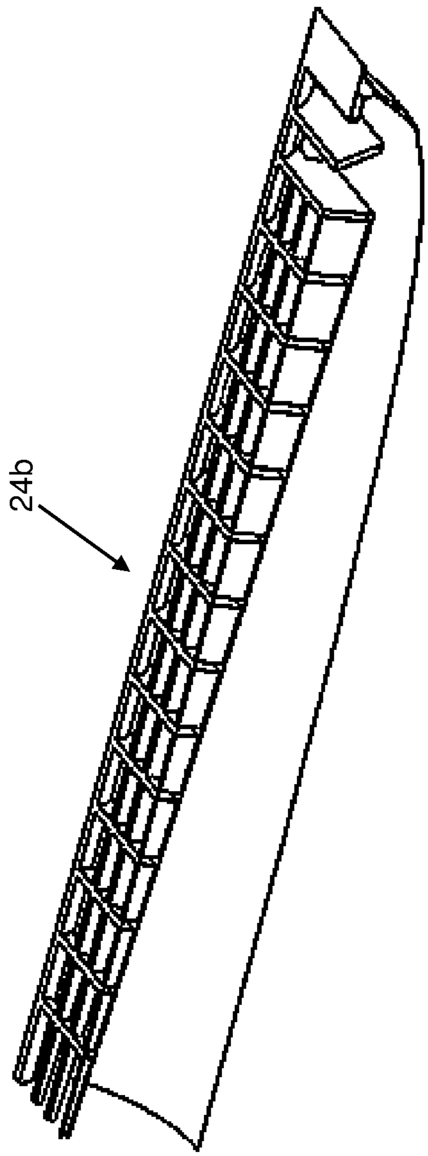

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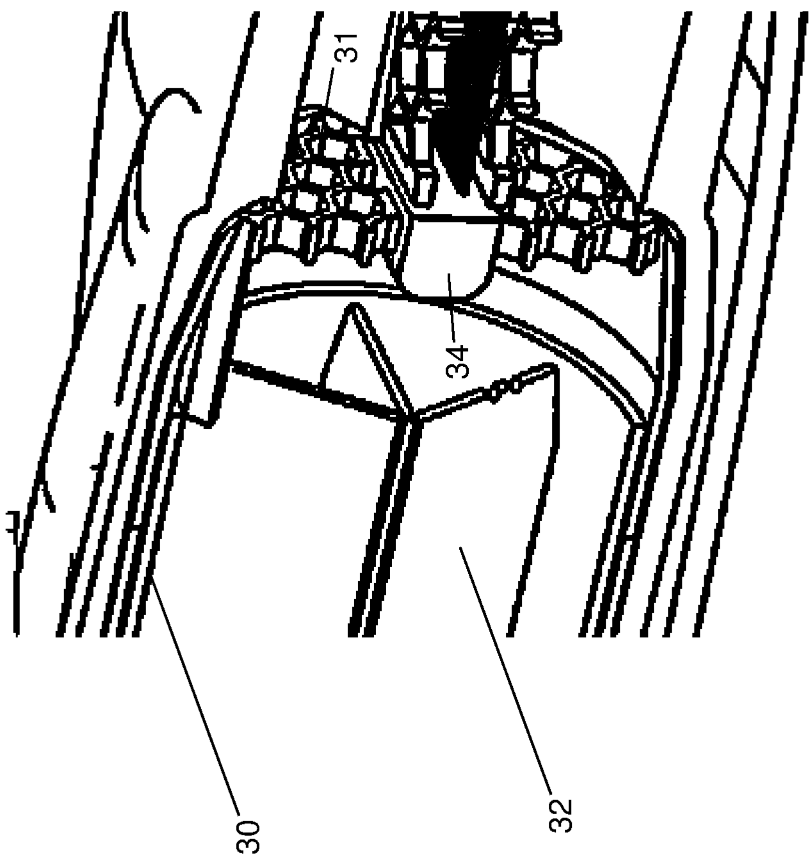

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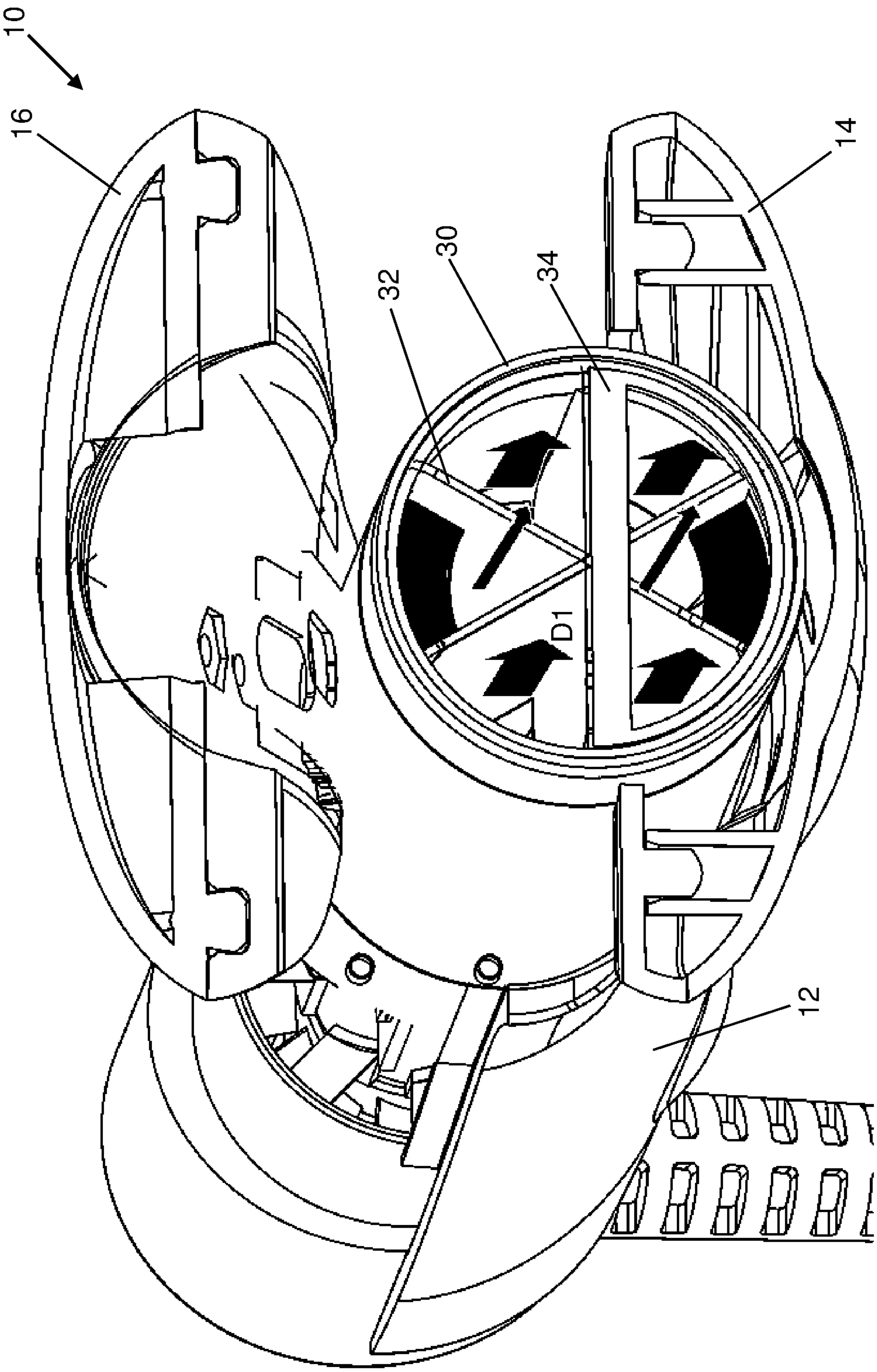


Figure 19

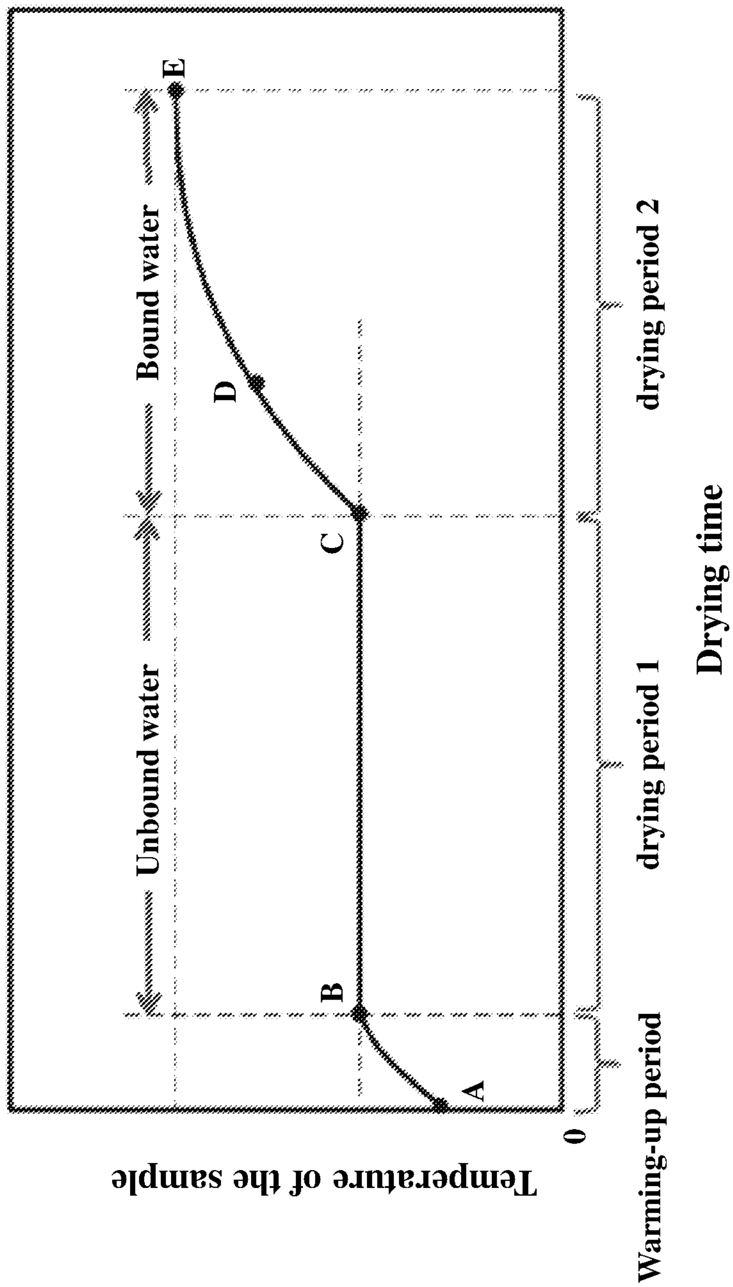
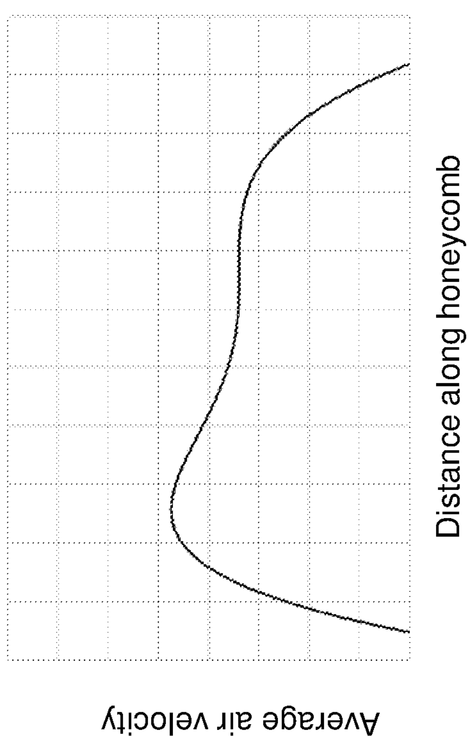

Temperature of the sample
0
A
B
C
D
E
Unbound water
Bound water
Warming-up period
drying period 1
drying period 2
Drying time

Figure 20



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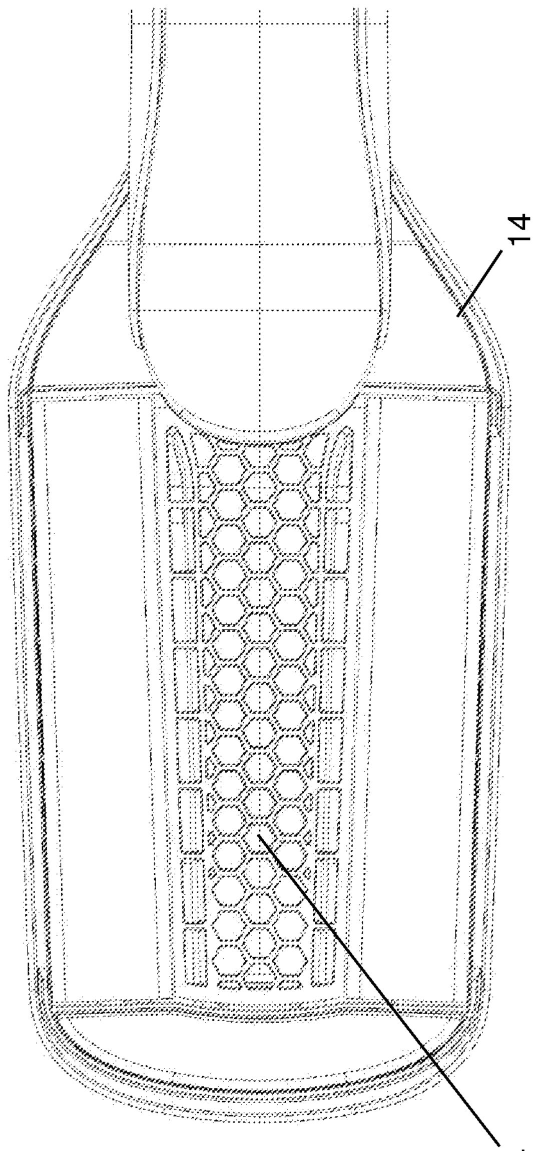

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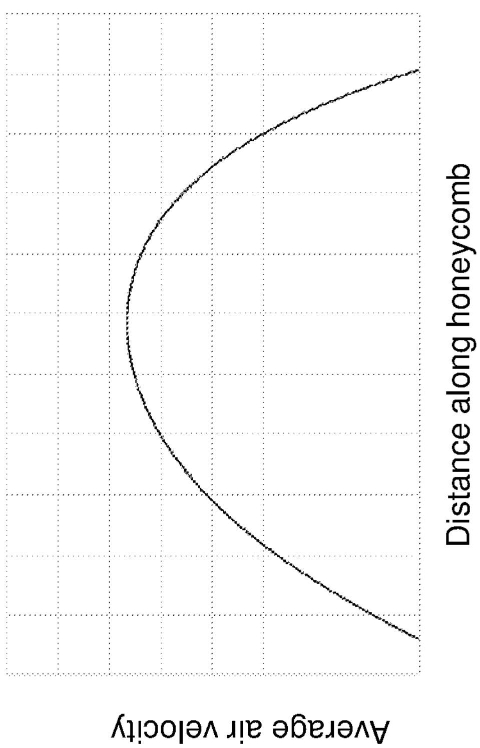

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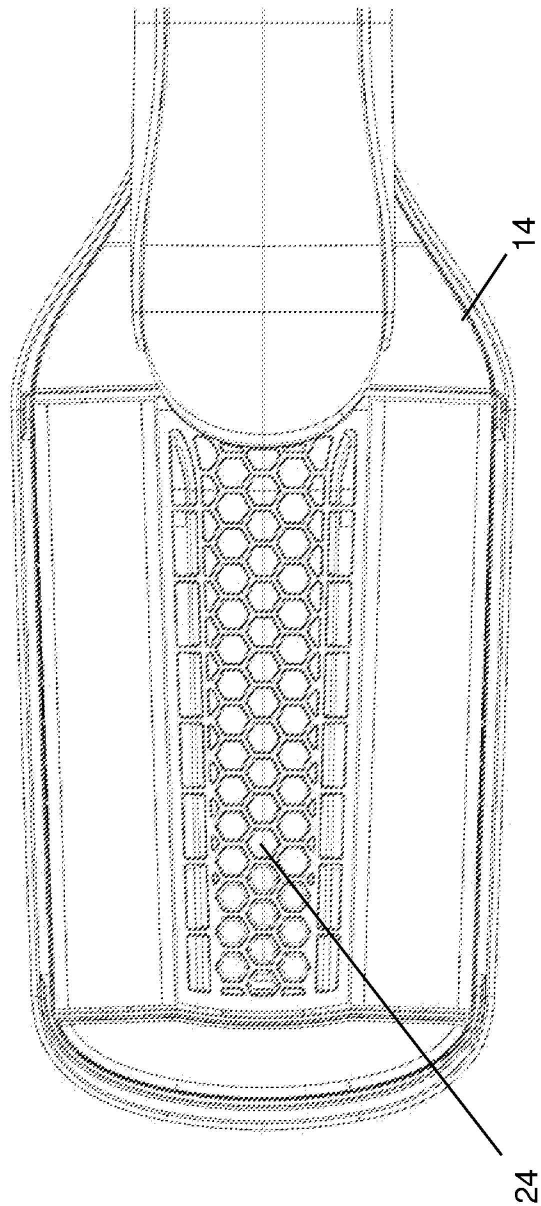

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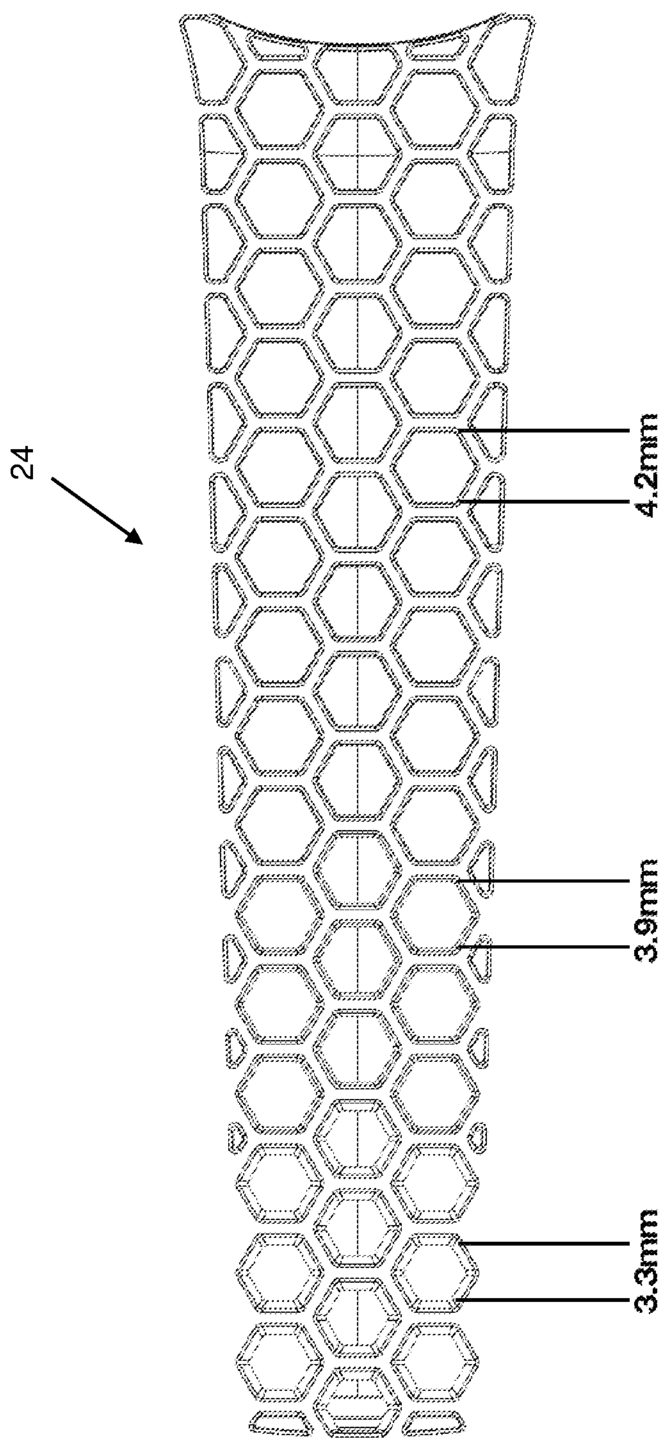

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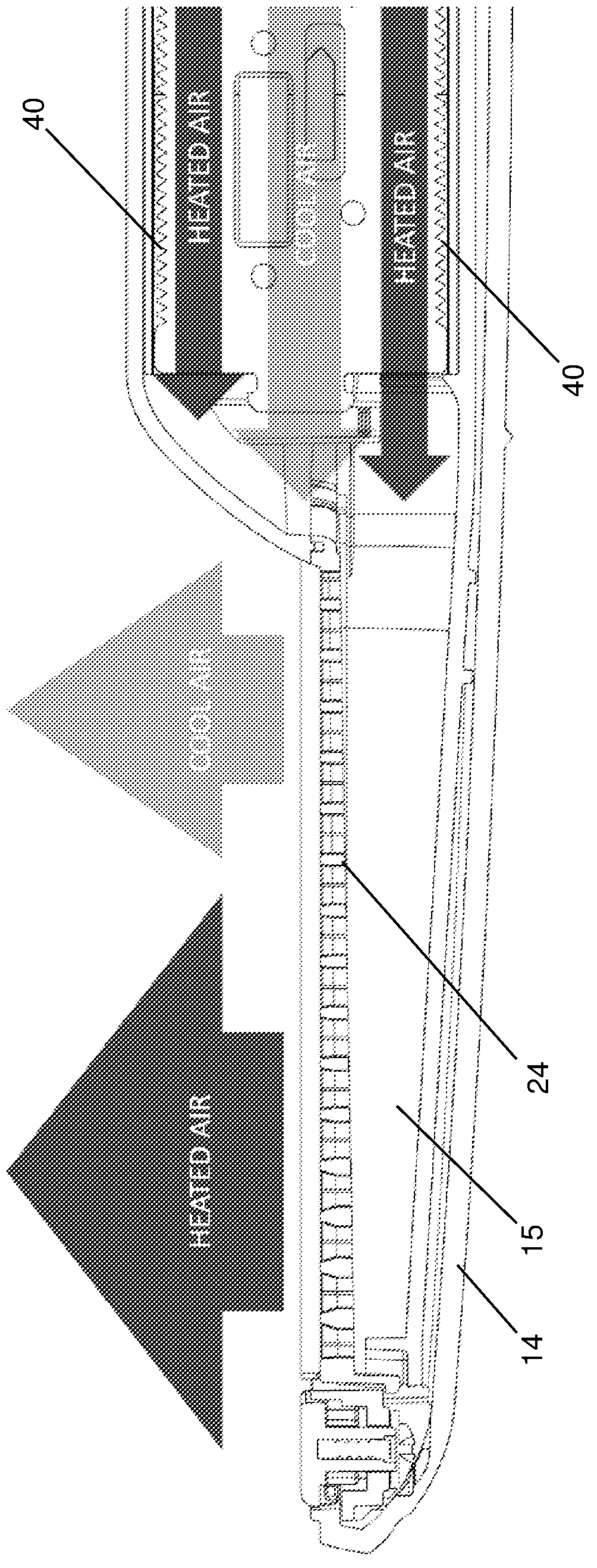
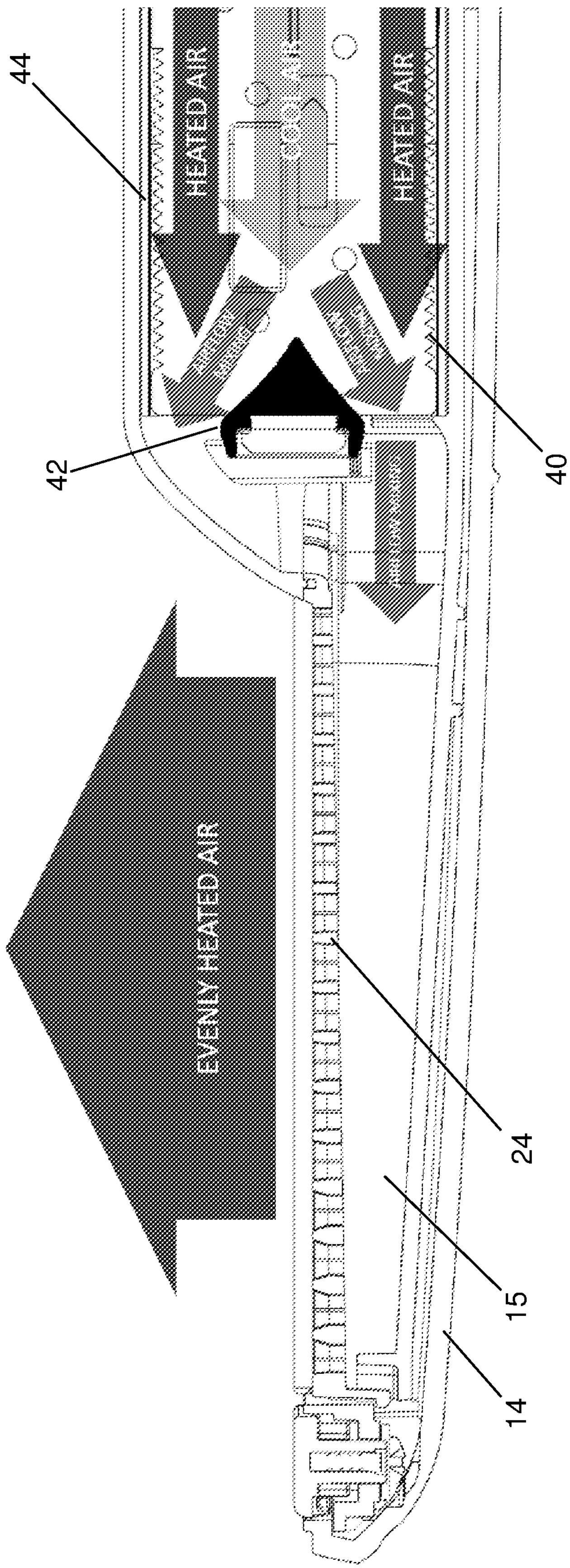

40
HEATED AIR
COOL AIR
HEATED AIR
40
COOL AIR
HEATED AIR
24
15
14

Figure 26



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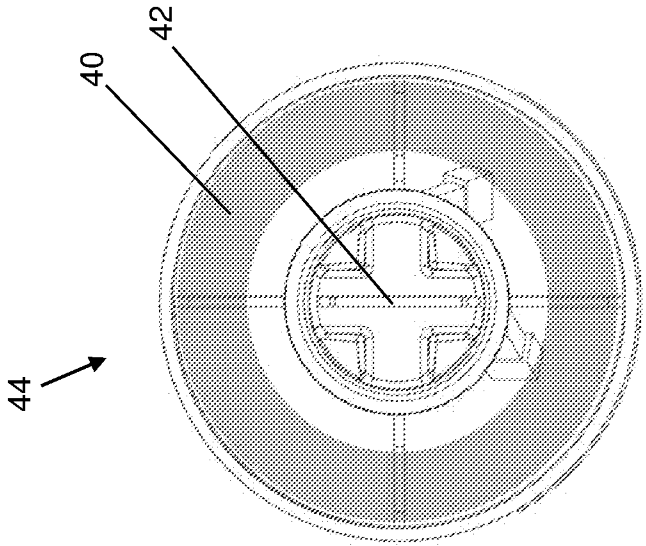

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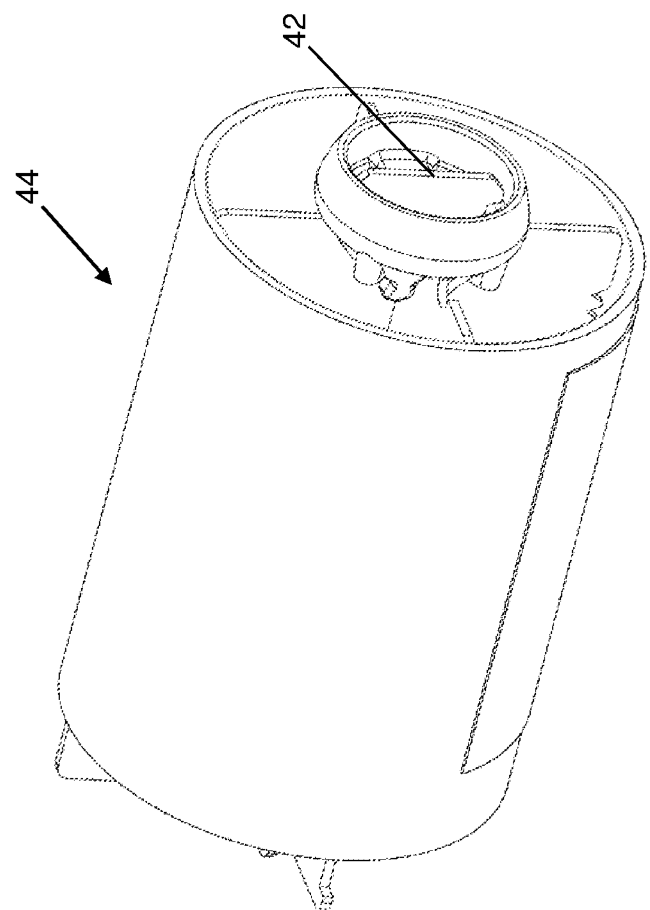

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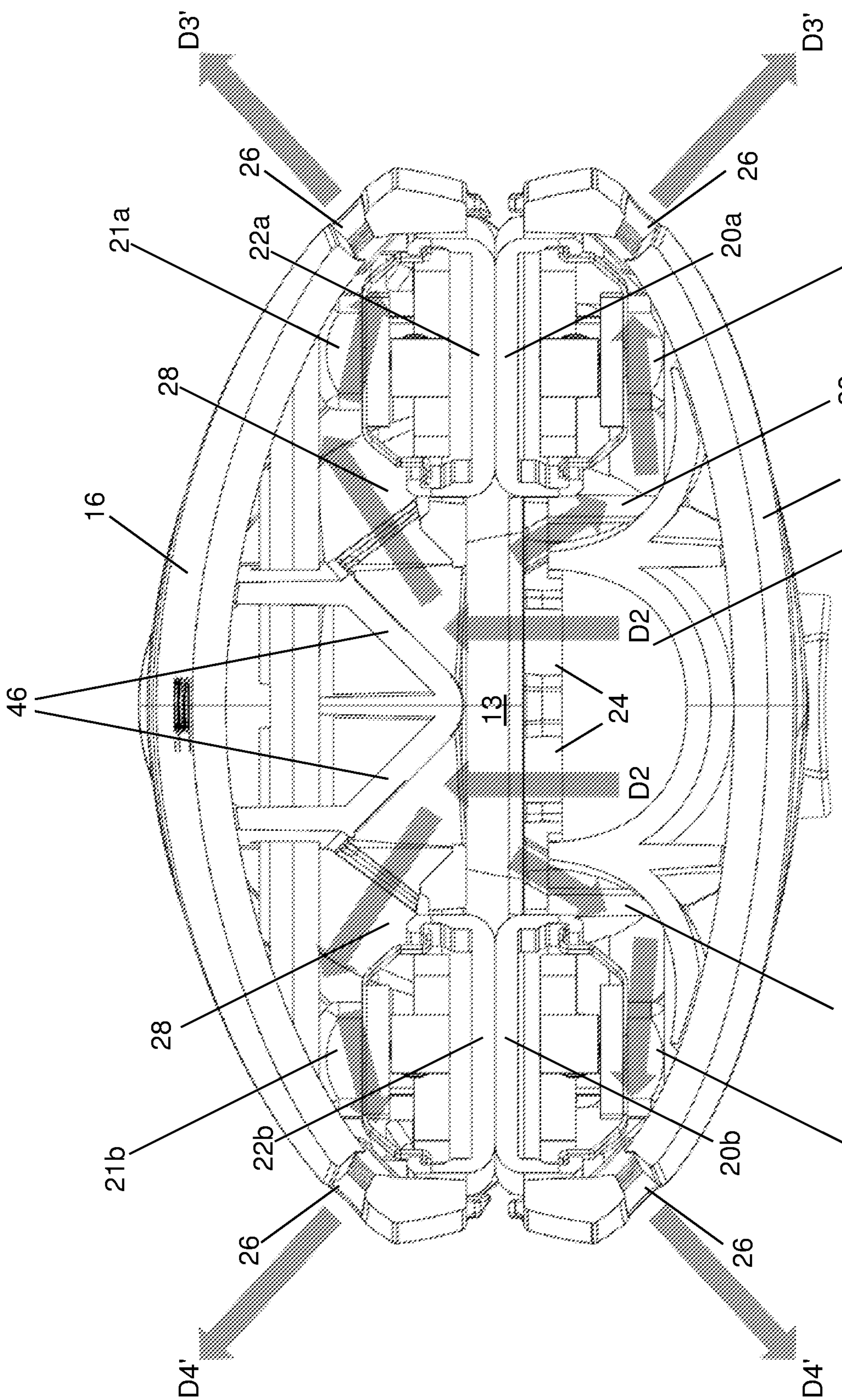
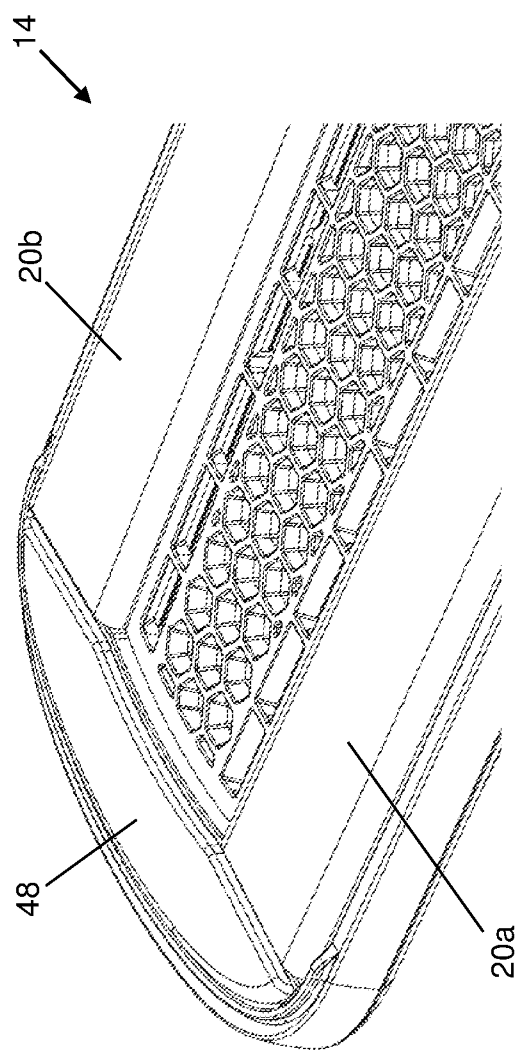

D3'
D3'
26
26
21a
22a
20a
19a
28
28
16
14
15
46
13
D2
D2
24
28
28
21b
22b
20b
19b
26
26
D4'
D4'

Figure 30



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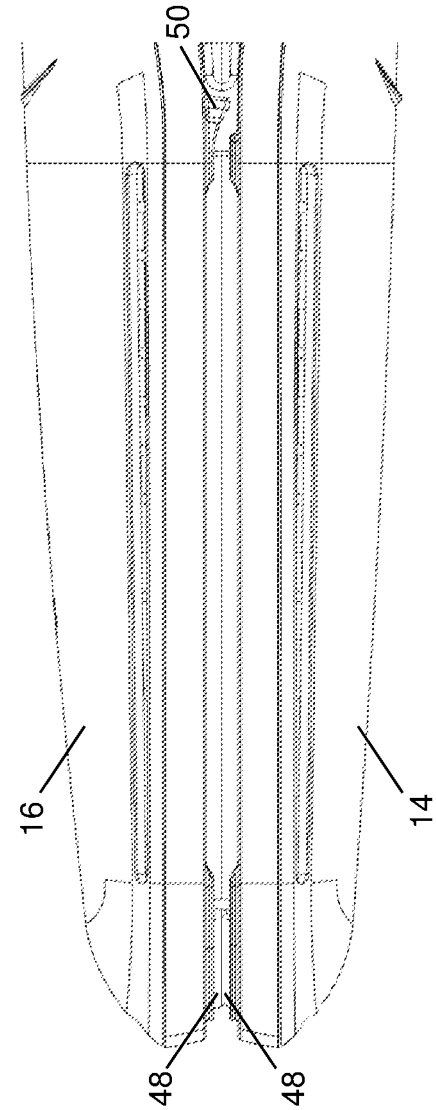

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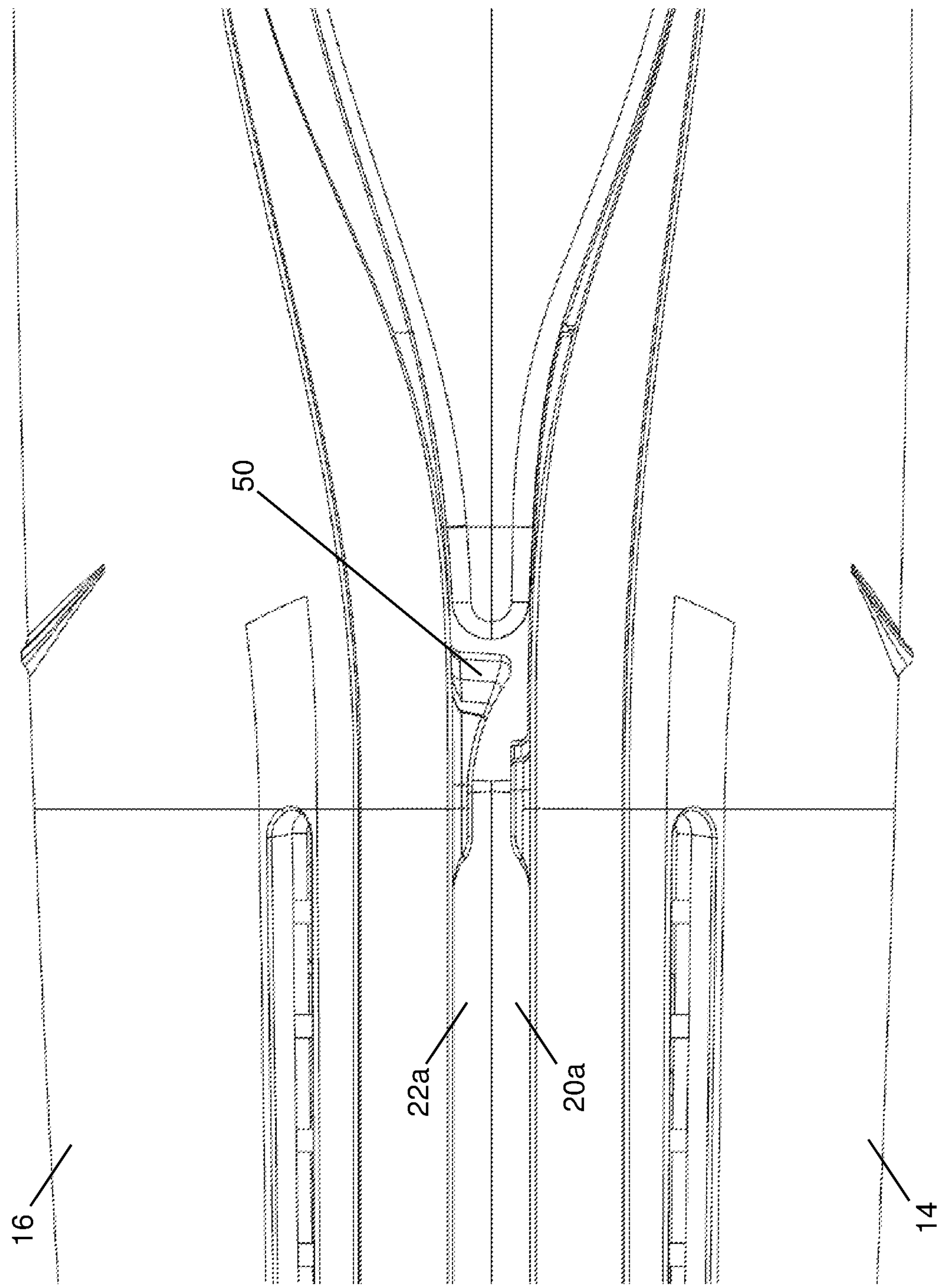

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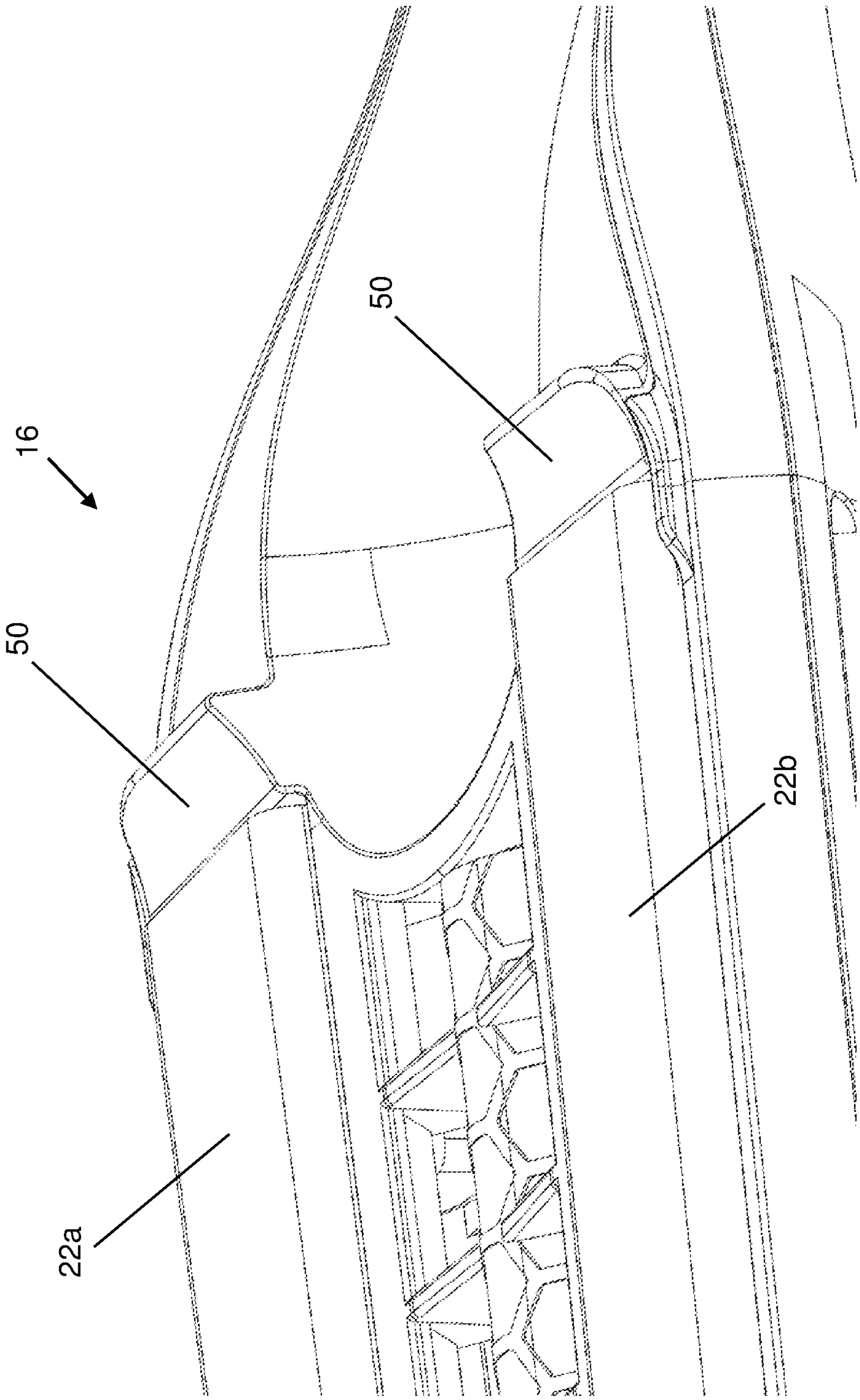

Figure 34

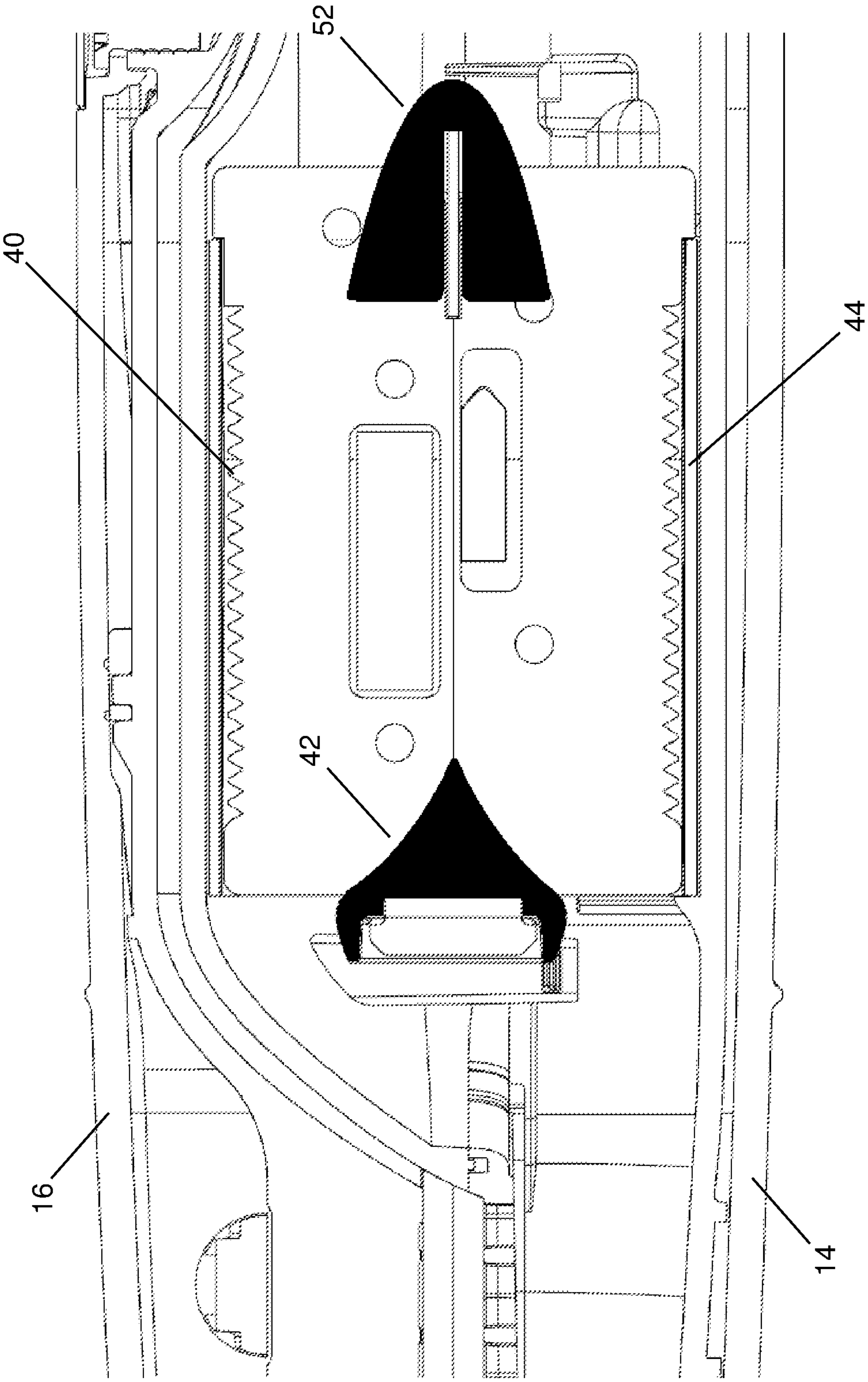

Figure 35

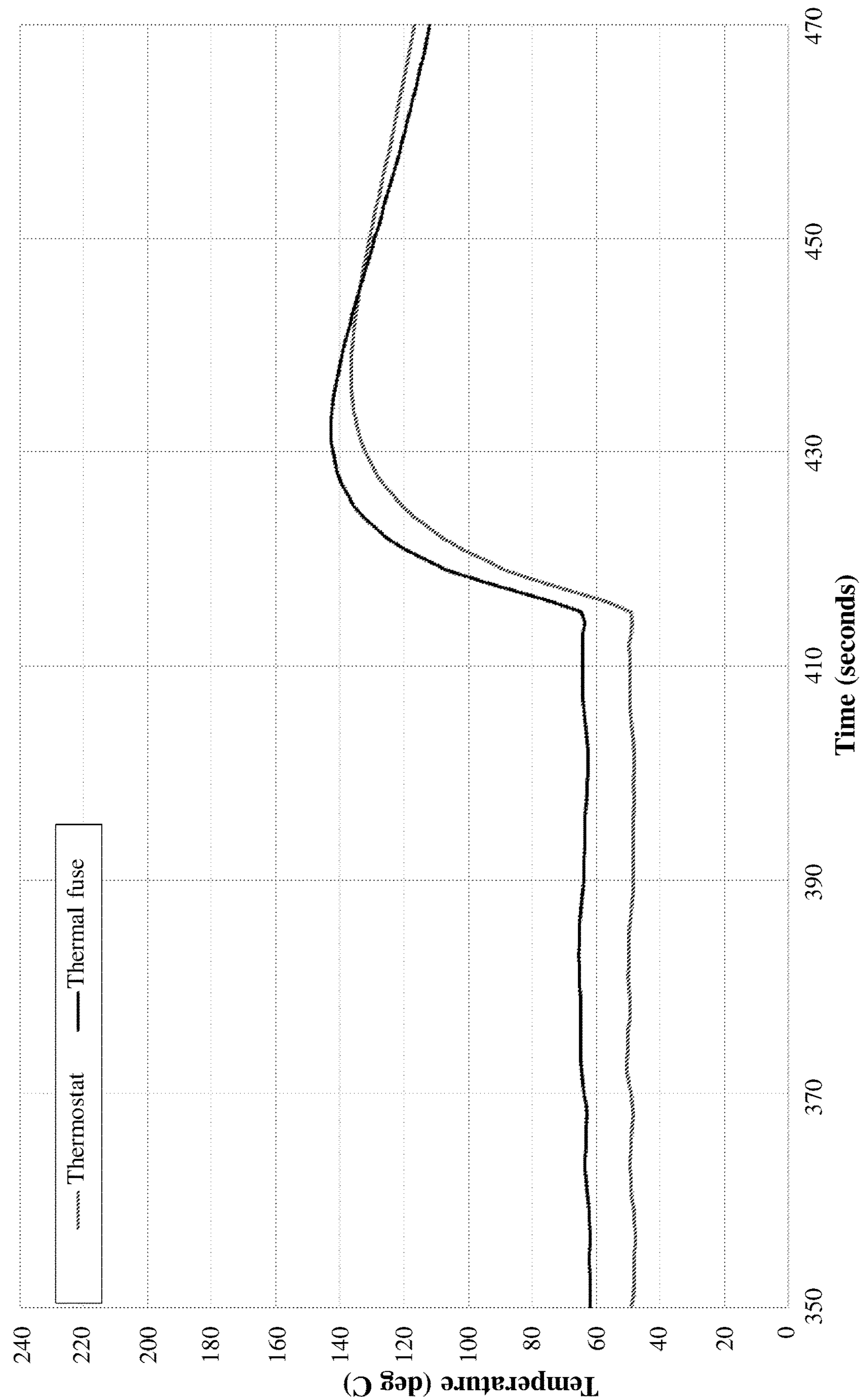
Thermostat
Thermal fuse
Temperature (deg C)
0
20
40
60
80
100
120
140
160
180
200
220
240
Time (seconds)
350
370
390
410
430
450
470

Figure 36

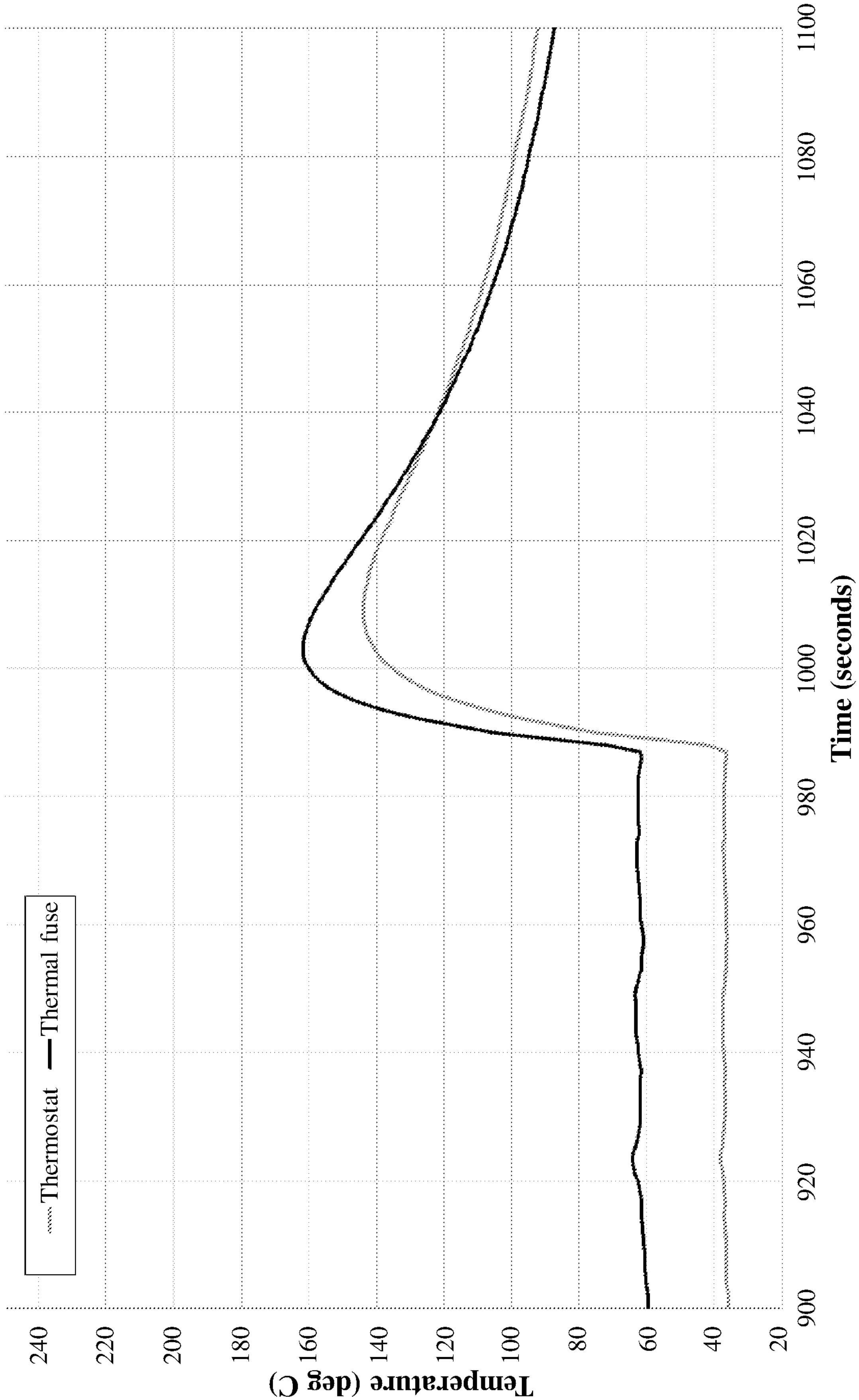
Thermostat
Thermal fuse
Temperature (deg C)
240
220
200
180
160
140
120
100
80
60
40
20
Time (seconds)
900
920
940
960
980
1000
1020
1040
1060
1080
1100

Figure 37

APPARATUS AND METHOD FOR DRYING AND STYLING HAIR

FIELD OF THE INVENTION

[0001] The present invention relates to an apparatus for drying and styling the hair of a person (or conceivably an animal), for example after washing the hair or as part of a styling process. That is to say, the hair is wet (or "towel-dry") prior to use of the invention, and may then be dried and styled using the invention. Such drying and styling of the hair may be performed by a user in respect of their own hair, for example, or by a hair stylist. It should also be noted that the term "wet" as used herein should be interpreted broadly, to encompass not only hair wetted by water, but also hair wetted by liquids other than water. For example, hair may be wetted by a solvent-based colourant, which the invention may be used to dry.

BACKGROUND TO THE INVENTION

[0002] Conventional handheld hairdryers, that incorporate an electrically-powered motorised fan to blow a current of cool or hot air in order to dry a person's hair, are well known. The fan draws ambient air into the body of the hairdryer and blows the current of air towards the hair to be dried. When hot air is to be blown, typically an electric heating element, incorporated within the body of the hairdryer, is used to heat the current of air before it leaves the hairdryer. Optionally, the hairdryer may be equipped with a concentrator nozzle attachment to intensify and direct the current of air, or a diffuser attachment to deliver the air more gently.

[0003] However, conventional hairdryers can often be noisy, heavy and bulky. Moreover, they can be awkward to use, and it can be difficult for a user (in particular a domestic user attending to their own hair) to achieve desired results, particularly in respect of styling the hair whilst drying it. For instance, a hairdryer will often be used simultaneously with a hairbrush or comb, or another piece of styling equipment, to style the hair during drying. The styling process may be, for example, to straighten the hair, or to provide "body and volume" to the hair (if necessary, preceded or succeeded by the application of styling products such as mousse, gel, wax, hairspray, etc.). Simultaneously manoeuvring a hairdryer and a brush (or a comb, etc.) around the head can be awkward for the user, and often requires a degree of skill to achieve the desired results.

[0004] Thus, whilst using a conventional hairdryer is the fastest method to dry hair, it can be very difficult and/or time-consuming to create a desired end result in respect of styling. To do this the user has to use a brush and/or additional hair styling tools.

[0005] As an alternative to conventional hairdryers, some people may use products such as hot air brushes or hot air paddle bushes when styling their hair. However, such products, whilst being easy to use, are slow in drying the hair.

[0006] A further category of products, that are both quick and easy to use, are so-called "wet to straight" hair straighteners. These are used to both dry and straighten hair, by drawing wet hair between a pair of heated plates mounted on opposing arms of the device. These devices tend to use conductive heating at high temperatures on wet hair (typically 185-230° C.) but can be damaging to hair, and/or may be perceived to be damaging to hair, due to sounds of cavitation (sizzle) or the use of elevated temperatures around the denaturation temperature of wet hair.

SUMMARY OF THE INVENTION

[0007] The present invention aims to provide alternative apparatus and methods to those of conventional handheld hairdryers in order to dry hair, by combining the functionality and benefits of a conventional hairdryer with those of a hair straightener, within one grip-sized device. Thus, advantageously, embodiments of the present invention provide, as a single handheld device, means for both drying and styling the hair, which is simple to use, and less awkward than manoeuvring a conventional hairdryer around the head simultaneously with a brush, comb or other piece of styling equipment.

[0008] According to a first aspect of the present invention there is provided apparatus for drying and styling hair, comprising:

- **[0009]** first and second mutually-opposing arms adapted for movement between an open configuration for receiving a length of wet hair therebetween and a closed configuration adjacent the hair, such that, in use, when the arms are in the closed configuration they form an inter-arm chamber across which the hair passes, and wherein an airflow conduit is provided within and along at least one of the first and second arms; and
- **[0010]** means for delivering a flow of air along the conduit in the at least one of the first and second arms, and subsequently into the inter-arm chamber.

[0011] The term "chamber" as used herein should be interpreted broadly, to encompass chambers that are partially open on at least one side, as well as those that are enclosed.

[0012] By virtue of the configuration of the present apparatus, including the at least one airflow conduit and the inter-arm chamber formed by the arms when in the closed configuration, this enhances the delivery of air to the hair, enabling the hair to be dried/styled in a quick and easy manner, and also enabling improved energy efficiency to be achieved.

[0013] Preferably one or both of the arms further comprises an airflow guide structure arranged to receive the flow of air from the respective conduit and to direct the flow of air from a first direction that is substantially parallel to the length of the respective arm, to a second direction that is from the respective arm towards the opposing arm, into the inter-arm chamber. The provision of such an airflow guide structure further enhances the delivery of air to the hair, further facilitating the drying/styling process, and enabling a further improvement in energy efficiency to be achieved.

[0014] In a particular embodiment each of the first and second arms comprises a respective conduit and a respective airflow guide structure, and the means for delivering the flow of air is arranged to deliver the air along the conduit in each of the first and second arms and thence through the respective airflow guide structure and into the inter-arm chamber. This enables air to be delivered to the hair in the device simultaneously from above and below, enhancing the drying/styling process.

[0015] Each airflow guide structure may be offset from an imaginary centreline midway between the first and second arms when in the closed configuration. Such an offset advantageously creates an airflow restriction between the air and hair in use, to increase the speed of the airflow around the hair, to increase drying. In a particular embodiment the offset of each airflow guide structure from the imaginary centreline is about 2 mm (i.e. the airflow guide structures are separated from one another by a distance of about 4 mm).

[0016] The conduit in the or each arm may advantageously act as a plenum chamber through which the air flows into the respective airflow guide structure and thence into the inter-arm chamber. This promotes uniformity of airflow from the or each arm through the respective airflow guide structure and into the inter-arm chamber.

[0017] Preferably the airflow guide structure in the or each arm comprises a cellular structure configured to direct the flow of air from the first direction to the second direction, the cellular structure comprising a plurality of cell walls which extend along the second direction into the respective plenum chamber.

[0018] The depth of the cells into the respective plenum chamber may progressively increase with distance along the respective arm. Such a configuration advantageously causes the incoming airflow in the first direction to turn and exit from the plenum chamber in the second direction and enter the inter-arm chamber with uniform airspeed.

[0019] Alternatively, or in addition, the diameter of the cells of the airflow guide structure in the or each arm may progressively decrease with distance along the respective arm. Such a configuration has been found to provide a more even distribution of airflow along the airflow guide structure.

[0020] In presently-preferred embodiments the cellular structure has a hexagonal (honeycomb) structure. The inventors have found this to be beneficial in maximising the open area through the guide structure whilst minimising the area occupied by the cell walls, and thereby minimising airflow resistance due to the cell walls.

[0021] The or each airflow guide structure may further comprise a plurality of airflow redirecting channels configured to convey the flow of air from the second direction to third and fourth directions that are outward from the apparatus, substantially perpendicular to the length of the arms. By expelling air in these third and fourth directions, this enables air to be easily directed towards the roots of the hair, to dry the roots and enable root lift to be created.

[0022] In presently-preferred embodiments the airflow redirecting channels extend between longitudinal edges and corresponding longitudinal sides of the airflow guide structure.

[0023] The device may further comprise mutually-opposing plates disposed on the first and second arms, the mutually-opposing plates being arranged to come together when the first and second arms are in the closed configuration. More particularly, first and second plates may be disposed on the first arm, and respective opposing first and second plates may be disposed on the second arm. At least one of said plates may comprise means for applying heat to said length of hair in use, when the first and second arms are in the closed configuration, thereby aiding the drying/styling process.

[0024] Airflow conduits may be provided that extend behind the first and second plates of the respective arm, to receive air from said airflow redirecting channels and to direct airflow behind the first plate and outward through vents along the edge of the apparatus in substantially the third direction, and to direct airflow behind the second plate and outward through vents along the edge of the apparatus in substantially the fourth direction.

[0025] In certain embodiments the airflow guide structure including the cellular structure and the airflow redirecting channels, and the outward vents in the third and fourth directions, may be formed as a unitary structure (e.g. by 3D printing).

[0026] Advantageously the outward vents may be oriented at an angle of about 45° relative to the plane of said plates, to enhance the degree of root lift created.

[0027] The device may further comprise an airflow splitter arranged to divide airflow into the conduits in the first and second arms in the first direction. Optionally the airflow splitter may comprise a flexible member.

[0028] The means for delivering the flow of air may comprise a fan. The fan may advantageously incorporate a brushless motor designed to operate at high speeds (e.g. over 30,000 revolutions per minute) and low power (e.g. 15 W maximum, 3 W during normal operation), and may driven by a DC power supply. Such high-speed low-power parameters of the fan have been found to provide excellent drying performance, drying hair as quickly as a 2000 W conventional hairdryer, but using significantly less power.

[0029] Presently-preferred embodiments further comprise means for heating said airflow, such as one or more heating elements or electrical heating coils, for example.

[0030] Advantageously, the apparatus may further comprise an airflow splitter arranged to direct incoming airflow towards said heating coils, thereby enhancing the efficiency of heat transfer from the coils to the incoming airflow during use. For example, the airflow splitter may be tapered or conical in shape.

[0031] Moreover, the apparatus may further comprise means for performing pulse width modulation in respect of electrical power applied to said means for heating said airflow. This can advantageously be used to regulate the thermal output of the means for heating, irrespective of variations in the power supply voltage (e.g. due to local variations in mains voltage around the world).

[0032] To promote a generally uniform air temperature profile across the air stream, the apparatus may further comprise means for causing turbulence in the heated airflow (such as one or more baffles within the airflow, or a conical or tapered airflow mixing member) prior to the airflow reaching the inter-arm chamber. Alternatively, the means for heating said airflow may comprise the airflow guide structure, the airflow guide structure being formed of a material that generates heat on application of an electric current thereto.

[0033] Optionally the apparatus may further comprise one or more sets of flexible bristles on the first and/or second arms, outside or within the inter-arm chamber, arranged to promote the application of uniform tension to the hair passing across the inter-arm chamber in use.

[0034] Advantageously, to prevent the escape of air past the end of each of the first and second arms, the apparatus may further comprise mutually-opposing spring-loaded sealing elements at the distal tip of said arms.

[0035] Moreover, the apparatus may further comprise at least one airflow deflector on the outer surface of at least one of said arms, shaped and positioned to deflect any rearward-flowing escaping air away from the user's hand. Such an airflow deflector may advantageously be ramp-shaped.

[0036] According to a second aspect of the present invention there is provided a method of drying hair using the apparatus of the first aspect.

[0037] The method may further comprise using the apparatus to style the hair substantially simultaneously with drying the hair.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] Embodiments of the invention will now be described, by way of example only, and with reference to the drawings in which:

[0039] FIG. **1** is a perspective overview of a combined hair dryer/styler device comprising means for blowing and heating air, an airflow splitter, and mutually-opposing drying/styling arms in an open configuration, with each arm incorporating a pair of heater plates and an airflow guide structure;

[0040] FIG. **2** shows the device of FIG. **1** with the arms in a closed configuration;

[0041] FIG. **3** illustrates the device of FIG. **1** in use;

[0042] FIG. **4** is a perspective longitudinal cross-sectional view of the device of FIG. **1**, showing some exemplary internal components;

[0043] FIG. **5** is a plan longitudinal cross-sectional view of the device of FIG. **1**;

[0044] FIG. **6** is a close-up perspective view of the arms of the device of FIG. **1** in the open configuration;

[0045] FIG. **7** is a side cross-sectional view of the arms of the device of FIG. **1** in the open configuration, through the airflow guide structure, showing the airflow guide structure of each arm as having a cellular structure in which the depth of the cells progressively increases with distance along the respective arm;

[0046] FIG. **8** is a side cross-sectional view as in FIG. **7** but with the arms in the closed configuration, and also illustrating directions of airflow along and between the arms;

[0047] FIG. **9** is a perspective view of the arms of the device of FIG. **1** closed around a representation of multiple strands of wet hair;

[0048] FIG. **10** is a transverse cross-sectional view through the arms of the device of FIG. **1** in the closed configuration, and also illustrating directions of airflow;

[0049] FIG. **11** is a transverse cross-sectional view corresponding to that of FIG. **10**, through the arms of the device in the closed configuration (around hair) and showing more detail;

[0050] FIG. **12** is a perspective longitudinal cross-sectional view along the arms of the device of FIG. **1** in the closed configuration around hair, illustrating airflow directional changes due to the airflow guide structure in each arm;

[0051] FIG. **13** is a perspective transverse cross-sectional view through the arms of the device of FIG. **1** in the closed configuration around hair, again illustrating airflow directional changes;

[0052] FIG. **14** is a perspective view of an arm component of the device of FIG. **1**, without plates, again illustrating airflow directional changes;

[0053] FIG. **15** is a perspective longitudinal cross-sectional view of the arm component shown in FIG. **14**, again showing the airflow guide structure as having a cellular structure (with hexagonal cells) in which the depth of the cells progressively increases with distance along the structure;

[0054] FIG. **16** is a perspective longitudinal cross-sectional view of an alternative embodiment of a cellular airflow guide structure, in this case having rectangular cells in one linear dimension (again with the depth of the cells progressively increasing with distance along the structure);

[0055] FIG. **17** is a perspective longitudinal cross-sectional view of another alternative embodiment of a cellular airflow guide structure, in this case having rectangular cells in two linear dimensions (again with the depth of the cells progressively increasing with distance along the structure);

[0056] FIG. **18** is a perspective longitudinal cross-sectional view of the airflow splitter of the device of FIGS. **1-15** in close-up, and also showing a plurality of baffles and a diffuser grille;

[0057] FIG. **19** is another view of part of the device of FIG. **1**, showing inter alia the plurality of baffles between the fan and the arms;

[0058] FIG. **20** is a graph of hair sample temperature against drying time, useful for understanding background principles;

[0059] FIG. **21** is a plan view of an example of an arm component in which the cells of the airflow guide structure are equal in diameter;

[0060] FIG. **22** illustrates the airflow distribution along the length of the airflow guide structure of FIG. **21**;

[0061] FIG. **23** is a plan view of another example of an arm component, in which the cells of the airflow guide structure decrease in diameter along the structure;

[0062] FIG. **24** illustrates the airflow distribution along the length of the airflow guide structure of FIG. **23**;

[0063] FIG. **25** provides exemplary dimensions of the hexagonal cells of the airflow guide structure of FIG. **23**, by way of example only;

[0064] FIG. **26** is a side cross-sectional view of an example of an arm component in which heated air and cool air are not mixed prior to reaching the airflow guide structure;

[0065] FIG. **27** is a side cross-sectional view of another example of an arm component, in which heated air and cool air pass over an airflow mixer prior to reaching the airflow guide structure;

[0066] FIG. **28** is a perspective view of a heater assembly having an airflow mixer (in the form of an airflow splitter) in the centre;

[0067] FIG. **29** is a transverse plan view of the heater assembly of FIG. **28**;

[0068] FIG. **30** is a transverse cross-sectional view through the arms of a variant of the device of FIG. **1** in a closed configuration, and illustrating directions of airflow (with the airflow originating from one arm only);

[0069] FIG. **31** is a perspective view of a sealing element at one end of an arm of a variant of the present device;

[0070] FIG. **32** is a side cross-sectional view of the two opposing arms of a combined hair dryer/styler device in a closed configuration, where each arm has a sealing element as in FIG. **31** that meet to prevent the escape of air from the end of the device;

[0071] FIG. **33** is a side cross-sectional view of the two opposing arms of a combined hair dryer/styler device, having a ramp feature behind the heater plate on one of the arms (in this case the top arm) to deflect airflow away from the user's hand;

[0072] FIG. **34** is a close-up perspective view of the ramp feature of FIG. **33**;

[0073] FIG. **35** is a side cross-sectional view of an air heater of a combined hair dryer/styler device, showing (using solid black fill to the left of the figure) an airflow mixer (airflow splitter) as per FIGS. **27** and **28**, to mix the air prior to reaching the airflow guide structure; and (using solid black fill to the right of the figure) an initial airflow splitter to direct incoming airflow towards the device's heating coils;

[0074] FIG. **36** shows, in relation to the device of FIG. **35**, plots of internal air temperature over time, in the region of a thermostat (lower line) and a thermal fuse (upper line) within the device, spanning the point when the device is switched from on to off and the internal fan stops; and

[0075] FIG. **37** shows, by way of comparison, corresponding plots to those of FIG. **36**, but without the presence of the initial airflow splitter of FIG. **35**.

[0076] In the figures, like elements are indicated by like reference numerals throughout.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0077] The present embodiments represent the best ways known to the applicants of putting the invention into practice. However, they are not the only ways in which this can be achieved.

[0078] Overview of Combined Hair Dryer/Styler Device

[0079] FIG. **1** is a perspective overview of a combined hair dryer/styler device **10** according to a first embodiment, with arms **14**, **16** in an open configuration, and FIG. **2** shows the same device with the arms **14**, **16** closed (as in use, e.g. as shown in FIG. **3**). FIGS. **4-15** show further views of parts of the device **10**, with FIGS. **8-14** showing parts of the device in use.

[0080] Referring initially to FIGS. **1** and **2**, the device **10** is an all-in-one handheld device that can be used to dry hair in a quick and easy manner, whilst also enabling styling of the hair (e.g. to straighten the hair, or to add "body and volume" to it).

[0081] The device **10** comprises a body part **12**, and first and second mutually-opposing arms **14**, **16** arranged in a broadly similar manner to the arms of a handheld hair styler. The first and second arms **14**, **16** are adapted for movement between an open configuration (as shown in FIG. **1**) for receiving a length of wet hair therebetween, and a closed configuration (as shown in FIG. **2**) adjacent the hair, to create tension in the hair, such that, in use, when the arms **14**, **16** are in the closed configuration they form an inter-arm plenum chamber (**13**, FIG. **10**) across which the hair passes.

[0082] Turning briefly to FIG. **7**, a first airflow conduit **15** is provided within and along the first arm **14**, and a second airflow conduit **17** is provided within and along the second arm **16**. In alternative embodiments (e.g. as illustrated in FIGS. **27**, **30** and **35**) only one of the arms may incorporate such an airflow conduit.

[0083] Referring to FIGS. **4** and **5**, the device further comprises a fan assembly **38** within the body part **12**, for delivering a flow of air along the first and second conduits **15**, **17** in the first and second arms **14**, **16**. The fan assembly **38** has an impeller and is typically also provided with a filter.

[0084] As shown for example in FIGS. **1**, **4**, **5**, **7** and **8**, each of the first and second arms **14**, **16** further comprises a respective airflow guide structure **24** arranged to receive the flow of air from the respective first or second conduit **15**, **17** and to direct (i.e. steer) the flow of air from a first direction (D**1**, FIG. **8**) that is substantially parallel to the length of the respective arm (i.e. incoming air, lengthways along the device), to a second direction (D**2**, FIG. **8**) that is from the respective arm towards the opposing arm, i.e. inwards into the inter-arm plenum chamber **13** formed by the arms **14**, **16** in the closed position. In alternative embodiments, only one of the arms **14**, **16** may be provided with such an airflow guide structure **24**, if only one of the arms incorporates an airflow conduit. The configuration and function of the airflow guide structure **24** are described in greater detail below. In yet other variants, the airflow guide structure(s) **24** may be omitted altogether.

[0085] As illustrated for example in FIG. **1**, the first arm **14** is a continuation of the body part **12**, and the second arm **16** is coupled to the body part **12** by means of a hinge **18**, by virtue of which the first and second arms **14**, **16** are movable relative to one other (in the illustrated embodiment, by moving the second arm **16** towards the first arm **14**). Thus, the first and second arms **14**, **16** can be brought together, into the closed configuration (as shown in FIG. **2**), or moved apart, into the open configuration (as shown in FIG. **1**), by a user in use. In the illustrated embodiment, each of the arms **14**, **16** widens relative to the body part **12** to form a "head" of the device **10**, distal from the body part **12**, although other embodiments are possible in which the head does not widen in the illustrated manner.

[0086] The hinge **18** can incorporate any suitable means for allowing the first and second arms **14**, **16** to be moved relative to one other.

[0087] Preferably the hinge **18** also incorporates spring means configured to bias the first and second arms **14**, **16** into the open configuration, such that the user is required to apply pressure to the arms to close them together (overcoming the effect of the spring means), and such that the arms **14**, **16** automatically open, under the effect of the spring means, once the pressure is removed. For example, the hinge **18** may incorporate a leaf spring or a coiled spring.

[0088] The hinge **18** and the spring means can be one and the same. For example, the spring means itself can be used to couple the second arm **16** to the body part **12**, thereby avoiding the need to provide a separate mechanical hinge and simplifying the overall construction of the device.

[0089] As shown in FIG. **1**, and in close-up in FIG. **6**, in the illustrated embodiment the inner surface of the first arm **14** incorporates first and second elongate heater plates **20***a*, **20***b*, parallel to each other and to the length of the arm **14**. The second arm **16** also incorporates first and second elongate heater plates **22***a*, **22***b* (not visible in FIGS. **1** and **6**, but shown for example in FIGS. **10** and **11**) in corresponding positions to heater plates **20***a* and **20***b*. Each of the heater plates is provided with a respective electrical heating element, operable to cause the respective heater plates to heat up. In the illustrated embodiment the operating temperature of the heater plates is typically around 120-130° C.

[0090] The first and second arms **14**, **16** and the first and second heater plates on each arm are arranged such that, when the device **10** is in the closed configuration, the first and second heater plates **20***a*, **20***b* of the first arm **14** come into contact with the first and second heater plates **22***a*, **22***b* of the second arm **16**. Preferably the heater plates **20***a*, **20***b*, **20***c*, **20***d* are made of a material having relatively high thermal conductivity, and are preferably provided with one or more temperature sensors (e.g. a temperature sensor for each plate, or one or more temperature sensors that each serves a plurality of heater plates).

[0091] Optionally, flexible bristles may be provided alongside the heater plates **20***a*, **20***b*, **20***c*, **20***d*. More particularly, flexible bristles may be positioned on either or both sides of the first arm **14**, and/or on either or both sides of the second arm **16**, adjacent to the inlet/outlet of the hair to/from the heater plates **20***a*, **20***b*, **20***c*, **20***d*. Alternatively, or in addition, flexible bristles may be provided within or around the airflow guide structure **24**, between the heater plates. Such bristles enable more uniform tension to be applied to the hair fibres within a section of hair passing through the chamber **13** formed by the arms **14**, **16** in the closed position.

[0092] As shown in FIG. **1**, a control button or switch **23** may be provided on the device **10**, to enable it to be turned on or off, together with an indicator light to show whether the power is on. A sound can also be played by a sound generator (not illustrated) when the device **10** is switched on and ready to use.

[0093] As shown in the cross-sectional views in FIGS. **4** and **5**, a fan assembly **38** is mounted towards an end of the body part **12**, distal from the first arm **14**. The fan **38**, driven by an electric motor, is operable to draw in air from the surrounding environment and to deliver a flow of air along the inside of the body part **12**; and then into and along the conduits **15**, **17** in the arms **14**, **16**; and then into and through the inter-arm plenum chamber **13** formed by the arms **14**, **16** in the closed position, around and through the hair to be dried.

[0094] Advantageously the fan **38** may incorporate a brushless motor designed to operate at high speeds (e.g. over 30,000 revolutions per minute) and low power (e.g. 15 W maximum, 3 W during normal operation), and may driven by a DC power supply. Such high-speed low-power parameters of the fan have been found to provide excellent drying performance, drying hair as quickly as a 2000 W conventional hairdryer, but using significantly less power.

[0095] An electrically-powered heating coil (or other electrical heating elements), operable to heat the air drawn in by the fan **38**, is provided in part **30**, towards the end of the body part **12** proximal to the first arm **14**.

[0096] The heater plates **20***a*, **20***b*, **22***a*, **22***b* serve a number of purposes during use of the device **10**. Firstly, with the user having sandwiched a length of wet hair between opposing plates **20***a* and **22***a*, and between opposing plates **20***b* and **22***b* (i.e. transversely across the plenum chamber **13** formed by the first and second arms **14**, **16** in the closed configuration), and by drawing the device along the length of wet hair, the heater plates **20***a*, **20***b*, **22***a*, **22***b* subject the wet hair to a squeegeeing effect, removing excess unbound water, and also heat the hair to promote subsequent evaporation of the water. Secondly, the heating provided by the heater plates **20***a*, **20***b*, **22***a*, **22***b* causes the walls of the plenum chamber **13** to be heated (via thermal conduction), and also helps maintain the temperature of the airflow delivered through the plenum chamber **13** by the fan **38**. Thirdly, the heater plates **20***a*, **20***b*, **22***a*, **22***b* can be used to style the hair, as an integral part of the drying process.

[0097] The heater plates **20***a*, **20***b*, **22***a*, **22***b* are preferably configured as ceramic float plates with springs having a low spring rate or stiffness, thereby giving good control of hair tension.

[0098] Allowing for the airflow heating coil (or other heater elements) and the heater plates **20***a*, **20***b*, **22***a*, **22***b*, as well as the fan **38**, the overall power consumption of the device **10** is around 600-800 W, which is significantly less than a 2000 W conventional hairdryer.

[0099] As shown in FIGS. **4** and **5**, the electrical and electronic circuitry of the device **10** is housed within the body part **12** and the first and second arms **14**, **16** (although predominately within the body part **12** and the first arm **14**). In the example illustrated, a printed circuit board assembly **36** is provided within the body part **12**. Electrical power is provided to the device **10** by means of a power supply located at the end of the body part **12** distal from the first arm **14**. In the illustrated embodiment the power supply is an AC mains power supply. However, in an alternative embodiment the power supply may comprise one or more DC batteries or cells (which may be rechargeable, e.g. from the mains or a DC supply via a charging lead), thereby enabling the device **10** to be a cordless product.

[0100] Amongst other things, the circuit board assembly **36** includes four TRIACs **37**, each for powering a respective one of the heater plates **20***a*, **20***b*, **22***a*, **22***b*.

[0101] Airflow Guidance

[0102] The device **10** incorporates a number of features that guide the airflow from the fan **38** to the user's hair **11** so as to enable the hair to be both dried and styled. These features will now be described in detail with particular reference to FIGS. **7**-**15**.

[0103] As mentioned above, and as shown for example in FIG. **7**, in the illustrated embodiment each of the first and second arms **14**, **16** (at the head of the device **10** distal from the body part **12**) comprises a cellular airflow guide structure **24** in airflow communication with a respective first or second conduit **15**, **17**. The first and second conduits **15**, **17** act as plenum chambers to supply air through the guide structure **24** of each of the first and second arms **14**, **16**.

[0104] Air is supplied to the first and second conduits **15**, **17** by the action of the fan **38**, via cylindrical part **30**. Part **30** includes a heating element to heat the air, and, as shown in close-up in FIG. **18**, a set of elongate baffles **32** (at a plurality of angles, essentially star-shaped in cross-section), an airflow splitter **34**, and a diffuser grille **31**.

[0105] The elongate baffles **32** are arranged to mix the air, to reduce hotspots from the heater in the region between the inlet of the air heater and the outlet from the cellular airflow guide structure **24**. This is of importance to achieve uniform air temperatures at the outlet of the cellular airflow guide structure **24**, thereby achieving uniform drying across the hair section within the chamber **13**. It also prevents the formation of hot spots in the air, which could damage the hair. Accordingly, without such baffles it may be necessary to reduce the hair heating power and therefore reduce the drying speed of the device.

[0106] The airflow splitter **34**, which is aligned across the diameter of the cylindrical part **30**, is arranged to split the incoming airflow into separate upper and lower airflows, which feed directly into the first and second conduits **15**, **17**. Advantageously, the shape of the airflow splitter **34** is such as to guide the air into the first and second conduits **15**, **17** without causing whistling from the air, thereby providing acoustic benefits.

[0107] More particularly, part **30** has a circular cross-section, the lower half of which (beneath the airflow splitter **34**) corresponds with the cross-sectional geometry of the first conduit **15**. The upper half of part **30** (above the airflow splitter **34**) corresponds with the cross-sectional geometry of the second conduit **17**. As shown in cross-section in FIG. **8**, as the second arm **16** is brought into the closed position the second conduit **17** fits snugly around the upper half of part **30**, so that airflow can pass through the part **30**, below and above the airflow splitter **34**, into the first and second conduits **15**, **17**, without leaking.

[0108] Thus, as shown in FIG. **8**, the air enters the first and second conduits **15**, **17** in a first direction D**1** that is substantially parallel to the length of each of the first and second arms **14**, **16**.

[0109] As also shown in FIG. **8**, and in perspective longitudinal cross-section in FIG. **15**, the airflow guide structure **24** in each of the first and second arms **14**, **16** includes a cellular structure comprising a plurality of cell walls. In the illustrated embodiment the cellular structure has a hexagonal (honeycomb) structure, although such a geometry is not essential and other geometries (for example as illustrated in FIGS. **16** and **17**) may be used instead. However, a hexagonal (honeycomb) structure has been found to be beneficial in maximising the open area through the guide structure **24** whilst minimising the area occupied by the cell walls, and thereby minimising airflow resistance due to the cell walls. In the illustrated embodiment the cell width is about one tenth the cell length.

[0110] It should be noted that the depth of the cells of the airflow guide structure **24** into the respective conduit/plenum chamber **15**, **17** progressively increases with distance along the respective arm **14**, **16**, in the direction away from the hinge **18**, towards the distal tip of the device. By virtue of this arrangement, incoming air in the first direction D**1** is steered from the first direction D**1** to a second direction D**2** that is substantially perpendicular to the first direction D**1**, inwardly towards the inter-arm chamber **13** that is formed by the arms **14**, **16** in the closed position.

[0111] More particularly, the gradual change in the depth of the cells of the airflow guide structure **24** into the respective plenum chamber **15**, **17** advantageously causes the incoming airflow in direction D**1** to turn and exit from the plenum chamber in direction D**2** and enter the inter-arm chamber **13** with uniform airspeed.

[0112] FIG. **8** also shows that, when the arms **14**, **16** are in the closed position, the inner face of each airflow guide structure **24** is offset from an imaginary centreline midway between the first and second arms **14**, **16** by a distance of 0.5 mm-4 mm (preferably about 2 mm). The position of the imaginary centreline is where hair **11** under tension will span the inter-arm chamber **13** in use (e.g. as shown in FIG. **9**). This offset of each airflow guide structure **24** from this imaginary centreline creates an airflow restriction between the air and hair in use, to increase the speed of the airflow around the hair, to increase drying.

[0113] The airflow guide structure **24** also includes a plurality of airflow redirecting channels **28**, which extend between longitudinal edges and corresponding longitudinal sides of the airflow guide structure **24**, as shown most clearly in FIG. **14**. These channels **28** are configured to convey the flow of air from the second direction D**2** to third and fourth directions D**3**, D**4** that are outward from the apparatus, substantially perpendicular to the length of the arms **14**, **16**, the fourth direction D**4** being opposite to the third direction D**3**. FIG. **13** also illustrates airflow directions D**3** and D**4**. Incidentally, as shown in FIG. **14**, the airflow guide structure **24** including the cellular (e.g. honeycomb) structure and the airflow redirecting channels **28**, along with the outward vents **26** in the third and fourth directions D**3**, D**4**, may be integrally formed as a unitary structure, e.g. by 3D printing.

[0114] Turning now to FIG. **10**, this illustrates further directions of airflow though the arms **14**, **16** of the device **10** when viewed in transverse cross-section, facing towards the body part **12** of the device.

[0115] Starting in the centre of FIG. **10**, the air flowing in direction D**2** can be seen entering the inter-arm chamber **13** from the plenum chambers **15**, **17** via the cells of the airflow guide structures **24**.

[0116] The air is then spread sideways and enters the airflow redirecting channels **28**, from which the air then passes along airflow conduits **19*a***, **19*b***, **21*a*** and **21*b*** to leave the device via vents **26** in opposing directions D**3** (via conduits **19*a*** and **21*a***) and D**4** (via conduits **19*b*** and **21*b***). As shown in FIG. **10**, airflow conduits **19*a***, **19*b***, **21*a*** and **21*b*** respectively extend behind the heater plates **20*a***, **20*b***, **22*a*** and **22*b*** that are mounted on the first and second arms **14**, **16**.

[0117] For completeness, it should be noted that, although the directions of the airflow D**3** and D**4** upon leaving vents **26** may be said to be "substantially perpendicular" to the length of the arms **14**, **16**, the overall path followed by the air as it passes through the airflow redirecting channels **28** and along airflow conduits **19*a***, **19*b***, **21*a*** and **21*b***, and then through the vents **26**, is not linear.

[0118] Advantageously, the vents **26** direct the outgoing air towards the roots of the hair, to dry the roots and create root lift.

[0119] FIG. **11** is a transverse cross-sectional view corresponding to that of FIG. **10**, through the arms **14**, **16** of the device **10** in the closed configuration (around hair **11**) and facing towards the body part **12** of the device. Looking along channels **15** and **17** in the direction of the body part **12**, features of the cylindrical part **30** can be seen, including the diffuser grille **31** and the elongate baffles **32** end-on. Other features of FIG. **11** correspond to those identified in FIG. **10** and described above.

[0120] FIGS. **12** and **13** illustrate (in perspective longitudinal and transverse cross-sectional views respectively) airflow directional changes due to the airflow guide structure **24** and other features in each of the arms **14**, **16** of the device **10**.

[0121] As noted above, the first airflow direction D**1** is substantially parallel to the length of each of the first and second arms **14**, **16**, as the air passes the baffles **32** and enters the first and second conduits (plenum chambers) **15**, **17** in the respective first and second arms **14**, **16**. Then the cellular airflow guide structure **24** directs (i.e. steers) the flow of air from the first direction D**1** to the second direction D**2** inwards into the inter-arm chamber **13** that is formed by the arms **14**, **16** in the closed position, through which the hair **11** passes in use.

[0122] The air is then spread sideways and enters the airflow redirecting channels **28**, from which the air then passes along airflow conduits **19*a***, **19*b***, **21*a*** and **21*b*** behind the heater plates to leave the device via vents **26** in opposing directions D**3** and D**4**.

Technical Principles

[0123] The expressions "to dry hair", "drying hair" and the like, as used herein, should be taken to refer primarily to the removal of "unbound" water that exists on the outside of hair when wet. Such "unbound" water should be contrasted with "bound" water, which exists inside individual hairs, and which can be interacted with when heat styling hair. There is no requirement to remove this "bound" water when drying hair in the context of the present invention, although removal of some bound water may occur during the drying process. Further removal of bound water usually occurs during the styling process.

[0124] FIG. **20** is a graph of hair sample temperature against drying time, useful for understanding the technical principles associated with the present work. As the temperature of the hair is increased, the hair goes through a warming-up period and then first and second drying periods, as set out below. The first drying period relates primarily to the removal of unbound water, and the second drying period relates primarily to the removal of bound water.

[0125] The "warming-up period": In this phase the ceramic heater plates are used to raise the temperature of the hair to that of the drying period where phase change of the liquid occurs (points A-B). The plates' surface cannot operate over 100-135° C. (nominally 120° C.) before water cavitation (sizzle) occurs on the plate.

[0126] The "drying period 1": This phase is supported by heated airflow to dry unbound water on the hair (points B-C). Without a freshly heated airflow supporting the evaporation the hair will quickly cool and the drying rate will slow.

[0127] The "drying period 2": This phase (points C-E) occurs when bound water on the hair evaporates and bound water is driven off from within the hair fibre.

[0128] Styling/straightening can be achieved when forces are applied to the fibres and the bound and unbound water is driven off.

Problems and Solutions Provided by the Present Work

[0129] In the present work the inventors have considered the following problems (amongst others) and have provided the following solutions thereto:

[0130] Problem 1—Reducing Volume of Fan Airflow and Air Heating Power to Fit within the Grip of the User's Hand

[0131] The inventors have determined that, in general, drying hair with heated air is an inefficient use of energy, although traditional hair dryer technology is efficient at converting electrical energy to a high temperature airflow. Moreover, using heated air alone to dry hair is very inefficient, with most of the energy being lost in hot air to the atmosphere. To dry hair faster, traditional hair dryers have used higher air pressures and large volume flow rates by employing increasingly high speed motor and fan technologies with air heating to increase drying rates. However, this leads to reduced energy inefficiency, increased unit costs and increased noise levels.

[0132] On the other hand, using conductive heating plates is a very efficient way of heating water and hair to dry, helping to increase a quick-drying, compact and quiet product. However over temperatures of ~100-143° C. (nominally) liquid water in contact with the metal plates causes an audible sound of cavitation (sizzle), which causes a perception of damage. Hair temperatures over 143° C. can lead to the denaturation of hair.

[0133] A possible solution to this would be to combine heated air blowing though conductive heater plates, but this would present an additional challenge by creating very high airflow resistance. This would require inefficient high-speed motor technologies to achieve the airflow pressures needed to pass hair through the hair and plates).

[0134] The solution provided by the present work is to enclose hair within a heated air plenum chamber **13** between conductive heater plates **20***a*, **20***b*, **22***a*, **22***b*. This enables the hair to be efficiently heated to evaporate more quickly toward the phase change temperatures of water with plate temperatures of ~100-143° C. (nominally 120° C.) to avoid cavitation and damage. Moreover, heated plenum temperatures of 125-175° C. (nominally 150° C.) enables us to efficiently support and maintain phase change and evaporation without cavitation.

[0135] Problem 2—Minimising the Range of Air Temperatures and Air Heating Power, Due to Large Variations in Airflow Resistance of Hair

[0136] The inventors have determined that hair, and wet hair in particular, has a large variation in airflow resistance, depending on the size and water content of the section. A solution is therefore needed to avoid excessive temperature rise (hair damage) and large variations in air heater power and fan pressure requirements.

[0137] The solution provided by the present work is that the plenum chamber **13** enclosed around the hair enables heated air to pass around the hair (not just through the hair section), reducing the range of airflow resistance of the system. This helps to reduce the heater power and range in power requirements to regulate the air temperature, thereby increasing energy efficiency and reducing product size and cost.

[0138] By reducing the range of resistance in the airflow requirements of the system this also in turn enables lower speed motors/fans to be used, helping to increase the energy efficiency of the fan, and to reduce sound and cost.

[0139] Moreover, by designing system resistance to accurately meet the airflow and temperature requirements to dry hair when closed, this enables the product's air temperature when open to be cooler, thereby helping to improve the drying experience to the user and reducing losses of energy, and reducing the physical size of the air heater which would otherwise make the product bigger and less easy to use.

[0140] Problem 3—Achieving Uniform Air Speed and Changing Air Direction at the Hair to Air Interface

[0141] The inventors have determined that achieving uniform air temperature and speed across the hair-to-air interface is beneficial to maintain drying efficiency. However to achieve this within the context of the present product form requires a method to turn the air, with uniform air speed and pressure at the hair-to-air interface.

[0142] The solution provided by the present work is the provision of an airflow path that incorporates various features for guiding or steering the airflow, as follows:

[0143] The airflow splitter **34**, which separates the airflow to the first and second arms **14**, **16**. It also prevents an excessive or uneven temperature rise on the edge of the section. It should be noted that the airflow splitter **34** can also be made larger and of a flexible material to vent air to the second arm **16** when the device is in the open condition. This prevents air blowing hair off the heater plates **20***a*, **20***b*, **22***a*, **22***b* when the device is in the open condition and prevents hair restricting the air outlet in the open condition that could lead to increased airflow restriction and resistance in the system, that could otherwise cause overheating and hair damage.

[0144] A plenum chamber **15**, **17** within each of the arms **14**, **16** that is shaped to allow airflow to fill each of the arms **14**, **16**, enabling more uniform airflow out of the cells of the cellular airflow guide structure **24**.

[0145] The cellular airflow guide structure **24** being of reduced cross-sectional width relative to the width of the arm **14**, **16** in which it is located.

[0146] The airflow guide structure **24** of each arm **14**, **16** having a cellular (e.g. honeycomb or louvered) structure that extends into the plenum chamber **15**, **17** within the respective arm, with the depth of the cells increasing in depth from the end of the arm proximal to the hinge **18**, to the end of the arm distal from the hinge **18**. This gradual change in the depth of the cells causes the airflow to turn and exit from the plenum chambers **15**, **17** with uniform airspeed.

[0147] An open offset distance from the nozzle outlet of the airflow guide structure **24** to the hair (when the first and second arms are in the closed configuration) of 0.5 mm-4 mm (nominally 2 mm) to create an airflow restriction between the air and hair, to increase the speed of the airflow around the hair, to increase drying. The open cross section between these features allows the air to pass around the hair to the plenum chamber outlet, without having to passing through the hair (which can otherwise restrict the airflow).

[0148] Problem 4—Achieving Uniform Air Temperatures in the Air Stream

[0149] The inventors have determined that achieving uniform air temperature across the air stream can be difficult if air heater windings are placed on the outer perimeter of an air duct (as is conventional practice). This causes the air temperature to be higher on the outer perimeter of the air stream relative to the centre of the air stream, giving a non-uniform distribution of heat across the air stream.

[0150] The solution provided by the present work is to place features in the air stream on the outside of the ring of the heater outlet, or inside the airflow, such as the baffles **32**, to cause turbulence in the heated airflow and promote better mixing of air in the air stream before passing the airflow splitter **34**. As a result, a more uniform air temperature profile across the air stream can be achieved.

[0151] Problem 5—Drying the Hair Roots and Creating Root Lift

[0152] The inventors have determined that it is desirable to dry hair at the roots, e.g. with a view to creating root lift.

[0153] The solution provided by the present work is to provide air outlet vents **26** at the side and/or rear of the conductive heater plates **20***a*, **20***b*, **22***a*, **22***b*. These vents **26** direct the outgoing air towards the roots of the hair, to dry the roots and create root lift.

[0154] Problem 6—Limitation of Plate Cavitation (Sizzle) with Very Wet Hair Over Around 100-125° C.

[0155] The inventors have determined that plate cavitation (sizzle) with very wet hair over around 100-125° C. is a limitation to drying speed.

[0156] The solution provided by the present work is based on the realisation that as the unbound water on the hair evaporates, the plate temperature can be elevated to higher temperatures, to heat and dry hair faster and more efficiently.

[0157] Accordingly, a method is provided to measure the level of unbound water on the hair (moisture sensing), to enable the plate and/or air temperatures to be increased to accelerate the drying rate further. This may be done by providing temperature sensors in the device **10**, for example in the following locations:

[0158] location "A"—upstream of the air to hair interface

[0159] location "B"—downstream of the air to hair interface

[0160] location "C"—to sense the temperature of the conductive heater plates, and/or power sensing

[0161] A very large temperature difference between these sensors will indicate the arms **14**, **16** are open, as the air will not be channeled past location B. The state of the arms **14**, **16** being open can also be sensed by measuring the electrical power needed to elevate the air temperature, as the airflow system resistance will also change between the states of being open, closed, and closed with hair in.

[0162] The thermal loading of the plates in location C will indicate that hair is in the product (from power and/or temperature sensing).

[0163] A high temperature difference between the sensors will indicate water is evaporating (drying hair) and thus the hair is wet. On the other hand, a low temperature difference between the plates will indicate minimal phase change is occurring, so the hair is "dry".

[0164] Problem 7—Increasing the Cooling Rate of the Heater Plates

[0165] As noted above, the inventors have determined that increasing the heater plate temperature in response to the presence of unbound water in hair enables faster drying. However if the user moves the device to a wetter section of hair the product's plates will ideally need to cool very quickly to prevent cavitation (sizzle) and or hair damage.

[0166] The present work provides a solution to this problem based on actively cooling the heater plates with air (from the fan) that passes over the plates. This enables accelerated cooling of the plates back down to 100-125° C. The air temperature can be controlled for example using an NTC (negative temperature coefficient) device and TRIAC control of the air heater.

[0167] A PTC (positive temperature coefficient) heater may also be beneficial to enabling a simple and compact conductive heater with an air heat sink.

[0168] Problem 8—Regulating the Air Temperature Contacting the Hair in Open Position

[0169] The inventors have determined that it can be advantageous to regulate the maximum temperature rise to hair when the air outlet is restricted with hair during loading, to prevent hair damage, and/or to minimise energy losses to the atmosphere, to deliver cooler feeling air to the user. It is also desirable to regulate the air temperature to achieve fast drying and minimal hair damage.

[0170] The present work provides a solution to this problem by placing a NTC (negative temperature coefficient) device at the air heater outlet, between the air heater and hair contact surface, with a preferred location closest to the hair interface at the outlet nozzle. This enables the NTC to respond to changes in airflow resistance caused by hair restriction or increased temperature differences caused by increased airflow resistance when the arms are open. TRIAC control can be used to regulate the power to the air heater if an upper temperature limit is reached.

[0171] Problem 9—to Refresh Hair on Days when the Hair is not Washed

[0172] The inventors have determined that users may wish to get a freshly washed and blow dry feeling to their hair on days when they do not have the time, ability or inclination to wash and dry their hair.

[0173] The present work provides a solution to this problem by enabling a fragrance to be emitted into the air stream generated by the device **10**, to give the hair a fresh smell. To achieve this, a user-replaceable piezo-atomiser and/or a simpler fragrance reservoir and wick may be used to enable phase exchange (liquid to gas) into the air stream and thence onto the user's hair.

[0174] Problem 10—to Create a Compact Air Heater to Make a Compact Overall Product Form

[0175] The inventors have determined that mains powered electrical air heaters are typically heated wire resistors formed to maximise the heated surface area in the air stream. This also adds complexity, size and cost, due to the requirement for a thermal fuse.

[0176] The present work provides a solution to this problem by recognising that a PTC (positive temperature coefficient) heater can enable a new form of air heater that merges the cellular (e.g. honeycomb) airflow guide structure **24** with an air heater, as a single product part. Thus, this merges the functionally of the two parts, making the overall product smaller and more compact. Moreover, because of the PTC effect, this can also negate the need for an additional thermal fuse (and the associated cost).

[0177] Problem 11—Portability

[0178] The inventors have determined that consumers desire products that are suitable for "on the go" use, e.g. away from home, or in any event away from plug sockets (e.g. in the bathroom).

[0179] By virtue of the above-described energy savings, the present work enables a low voltage (LV) device **10** to be used for safe operation in the bathroom, and/or enables the device **10** to be used cordlessly (e.g. with a rechargeable battery) and/or a compact isolated power supply.

MODIFICATIONS AND ALTERNATIVES

[0180] Detailed embodiments and some possible alternatives have been described above. As those skilled in the art will appreciate, a number of modifications and further alternatives can be made to the above embodiments whilst still benefiting from the inventions embodied therein. It will therefore be understood that the invention is not limited to the described embodiments and encompasses modifications apparent to those skilled in the art lying within the scope of the claims appended hereto.

[0181] In the embodiments described above, each of the first and second arms **14**, **16** contains a respective airflow conduit **15**, **17** and is provided with a respective airflow guide structure **24**. However, in alternative embodiments, only one of the arms **14**, **16** may be provided with an airflow conduit and airflow guide structure **24**. Examples of such variants will be described below and are illustrated by way of example in FIGS. **27**, **30** and **35**. In yet other variants, the airflow guide structure(s) **24** may be omitted altogether.

[0182] In the embodiments described above, heater plates are provided symmetrically on either side of each arm **14**, **16**. However, as those skilled in the art will appreciate, it is not necessary that both these plates be heated, and in alternative embodiments only one plate may be heated, or neither of the plates may be heated. The squeegeeing effect of the plates may be sufficient in some circumstances to dry the hair in combination with the airflow, without either or both the plates being heated. Furthermore, unheated plates may be used to apply tension to the hair to provide a degree of styling. However, having at least one heater plate is preferred as it helps with the drying/styling process. Moreover, using a pair of heater plates, as in the embodiments described above, advantageously allows for bidirectional/ambidextrous use of the device.

[0183] In the embodiments described above, the airflow guide structure **24** in each of the first and second arms **14**, **16** comprises a cellular structure having hexagonal (honeycomb) cells, configured to direct the flow of air from the first direction D**1** to the second direction D**2**. However, in alternative embodiments, the cells of the airflow guide structure may be different shapes. For example, FIG. **16** shows an perspective longitudinal cross-sectional view of an alternative cellular airflow guide structure **24*a***, in this case having rectangular cells in one linear dimension (with the depth of the cells progressively increasing with distance along the structure, in the same manner as the hexagonal cells described above). As another example, FIG. **17** shows a perspective longitudinal cross-sectional view of another alternative cellular airflow guide structure **24*b***, in this case having rectangular cells in two linear dimensions (again with the depth of the cells progressively increasing with distance along the structure).

[0184] In the embodiments described above, the airflow is heated, e.g. by a heater element in the body **12** of the device, downstream of the fan **38**. However, in alternative embodiments the means for heating the airflow may comprise the airflow guide structure **24** itself, the airflow guide structure being formed of a material that generates heat on application of an electric current thereto. In other alternative embodiments the device may not heat the air, relying instead on delivering air at a sufficiently high flow rate to dry the hair.

[0185] Throughout the description and claims of this specification, the words "comprise" and "contain" and variations of the words, for example "comprising" and "containing", means "including but not limited to", and is not intended to (and does not) exclude other components, integers or steps.

[0186] Further alternative features in relation to the embodiments described above have been developed to address particular additional problems or to provide particular additional functionality. These further alternative features (and, as applicable, the particular problems they address or the additional functionality they provide) will now be described in detail.

[0187] To begin with, in order to achieve rapid drying but also a high quality of styling (i.e. high levels of shine, colour retention and style longevity), hair tresses passing through the active styling area (i.e. the head of the styler) should be subjected to even drying and heating across the width of the tress. To do this well, the following five considerations have been found to be important:

[0188] (1) Airflow distribution across the active styling area (i.e. the head of the styler) should be as even as possible.

[0189] (2) The temperature distribution of the air passing through the styling area should be as even as possible.

[0190] (3) The root lifting vents should be arranged to optimise their functionality.

[0191] (4) Air should not be allowed to escape from the tip of the styler when the styler is closed around hair and is being used.

[0192] (5) The styler should perform equally well in any country. Typically there are minor differences in mains voltage between countries which can lead to changes in motor speed and power available to the air heater, hence the energy transferred to the hair can be different. This should be resolved such that in any country and regardless of mains voltage the energy transfer is the same, to ensure consistent and even performance across the world.

[0193] Safety and quality of the product are also extremely important, of course, and hence the following issues have also been considered and addressed:

[0194] (6) Hot air should not be allowed to flow onto the hand of the user when the styler is being operated.

[0195] (7) A build-up of residual heat in the air heating components (and associated electronics) should be avoided, to prevent inadvertent shutdown or failure of temperature-sensitive components such as a thermal fuse, particularly at the time when the device is switched from on to off.

[0196] The above points (1) to (7) have been addressed through the following further features, as follows:

[0197] Further Feature 1—to Provide More Even Airflow Distribution Across the Active Styling Area (i.e. the Head of the Styler)

[0198] In the embodiments described above, the design of the cellular airflow guide structure **24** seeks to provide even airflow by using a honeycomb (or other cellular) structure in which the depth of the cells progressively increases towards the distal tip of the device, to effectively "scoop up" more air as it progresses down the length of the head in a direction perpendicular to the depth direction of the cells. While this technique is helpful, with the above-described cellular airflow guide structure **24** it has nevertheless been found that a disproportionate amount of the airflow is still emitted near the distal tip of the device.

[0199] To illustrate this, FIG. **21** shows the above-described cellular airflow guide structure **24** of the lower arm **14** of the device, in which the hexagonal cells are equal in diameter. Aligned with FIG. **21**, FIG. **22** illustrates the airflow distribution along the length of the airflow guide structure **24**—i.e. the average emitted air velocity at each longitudinal position along the airflow guide structure **24**, from the tip end to the handle end along the head of the device. From FIG. **22** it can indeed be seen that a disproportionate amount of the airflow leaves the airflow guide structure **24** near to the distal tip of the device, due to a build-up of airflow towards the tip of the device. This is not conducive to even styling, and will lead to less shine on the hair, and individual strands of hair being blown in unwanted directions (so-called "fly away" hair strands), especially near the tip of the device, due to the greater velocity of the emitted air in that location.

[0200] To resolve this issue, and with reference now to FIG. **23**, in an alternative (improved) airflow guide structure **24** the diameter of the honeycomb cells is progressively reduced towards the distal tip of the device, to restrict the airflow. The depth of the cells also progressively increases towards the distal tip of the device, as described above. FIG. **24** shows the resulting airflow distribution along the length of the airflow guide structure **24**, from which it can be seen that a more even distribution of airflow is achieved, with a peak in airflow located around the midpoint of the airflow guide structure **24**, i.e. midway between the tip end and the handle end of the head of the device. Such an airflow distribution leads to more even styling, more shine on the hair, and fewer occurrences of individual strands of hair being blown in unwanted directions.

[0201] FIG. **25** provides exemplary dimensions of the hexagonal cells of this alternative airflow guide structure **24**. It can be seen that the cells proximal to the handle of the styler have a diameter of 4.2 mm, the cells around the midpoint of the airflow guide structure **24** have a diameter of 3.9 mm, and the cells near to the distal tip of the device have a diameter of 3.3 mm. These dimensions are by way of example only, and may be different in other implementations (whilst still progressively reducing the diameter of the cells towards the distal tip of the device). For the sake of completeness, it should be noted that the progressive reduction in the diameter of the cells need not be continuous along the length of the airflow guide structure **24**, but may decrease in a stepwise manner, i.e. in discrete stages.

[0202] Further Feature 2—to Provide a More Even Temperature Distribution of the Air Passing Through the Styling Area (i.e. the Head of the Styler)

[0203] The temperature of the air being passed through the head of the styler should be as even as possible to ensure that drying is even across the tress, to result in better hair fibre alignment and improved shine and style longevity. The above-described structure (e.g. with reference to FIG. **7**) whereby air passes from part **30** into the first airflow conduit **15** (provided within and along the first arm **14**) and into the second airflow conduit **17** (provided within and along the second arm **16**) has been found to not provide as even a temperature distribution as would be desirable. This is due to the manner in which the airflow into the conduits **15**, **17** is created, and the design of the heater—particularly the annular configuration of the heating element which leads to a cooler centre core of the airflow.

[0204] The result of this issue is that a difference of over 30° C. in the temperature of the emitted air may be observed from one end of the airflow guide structure **24** to the other. For instance, in representative experimental tests, an emitted air temperature of 51° C. was measured near to the proximal end of the airflow guide structure **24** (i.e. close to the handle), a temperature of 71° C. was measured around the midpoint of the airflow guide structure **24**, and a temperature of 86° C. was measured near to the distal end of the airflow guide structure **24**, near to the tip of the device.

[0205] A similar situation is illustrated in FIG. **26**, in which heated air is emitted near the distal end of the airflow guide structure **24**, and cool air is emitted at the proximal end of the airflow guide structure **24**. This is due to the annular configuration of the heating element **40** (within a heater assembly **44**) which causes regions of heated air to be generated adjacent to the heating element **40**, and a cooler central core of air to be generated between the heated regions.

[0206] In passing, it should also be noted that FIG. **26** (and subsequently FIGS. **27**, **30** and **35**) show a variant of the first arm **14** in which all the incoming airflow is directed along the first airflow conduit **15**, and thence through the airflow guide structure **24**. That is to say, in this example, the second arm **16** does not comprise a second airflow conduit for delivering air to the head of the styler (but may nevertheless comprise an airflow guide structure in communication with the inter-arm chamber **13**, for receiving the air emitted from the first arm **14**). Conversely, in another variant, all the incoming airflow may be directed along the second airflow conduit **17**, within the second arm **16**, and none along the first arm **14**. Such variants may enable easier manufacture of the overall device, and may also improve airflow performance, as they avoid having opposing airflows from the first and second conduits **15**, **17** coming into conflict with one another and causing turbulence within the inter-arm chamber **13**, and moreover provide a well-defined "escape route" for moisture-laden air.

[0207] With reference to FIG. **27**, the above issue of uneven temperature distribution may be addressed by providing an airflow mixer **42**, in this case in the form of an airflow diverter or splitter, near to the end of the heater assembly **44**, before the airflow conduit **15**. The airflow mixer **42** causes the heated air (from adjacent to the heating element) to mix with the cooler central core of air, to provide a more evenly heated flow of air along the airflow guide structure **24**. The airflow mixer **42** may be generally tapered or conical in shape, as illustrated, or some other shape so as to cause turbulence and mixing of the air within the airstream.

[0208] By virtue of the airflow mixer **42** removing or reducing the cool core of air, the temperature difference of the emitted air from one end of the airflow guide structure **24** to the other can be considerably reduced. For instance, in comparative experimental tests in which the airflow mixer **42** was present, an emitted air temperature of 68° C. was measured near to the proximal end of the airflow guide structure **24** (i.e. close to the handle), a temperature of 82° C. was measured around the midpoint of the airflow guide structure **24**, and a temperature of 80° C. was measured near to the distal end of the airflow guide structure **24**, near to the tip of the device. Accordingly, in this case, the difference in temperature from one end of the airflow guide structure **24** to the other was only 12° C.

[0209] FIG. **28** is a perspective view of the heater assembly **44** as present within FIG. **27**, showing the airflow mixer **42** in the centre. Similarly, FIG. **29** is a transverse plan view of the heater assembly **44** of FIG. **28**, and also showing a representation of the heating coils **40**.

[0210] Further Feature 3—to Improve the Functionality of the Root Lifting Vents

[0211] In the embodiments described above and as illustrated in FIG. **10**, for example, the root lifting vents **26** are located along either side of the head of the styler head and extend parallel to the plane of the heater plates **20***a*, **20***b*, **22***a*, **22***b*.

[0212] However, with reference now to FIG. **30**, further development work has found that improved lifting of the roots of the hair may be achieved if the air leaves the vents **26** at around 45° to the plane of the heater plates **20***a*, **20***b*, **22***a*, **22***b*, in directions D**3'** and D**4'**, rather than parallel to the plane of the heater plates. This means the air flow direction D**4'** is not opposite to D**3'** on either side of the styler head (unlike directions D**3** and D**4** shown in FIG. **10**). Rather, the air flow directions D**3'** and D**4'** are at around 90° to each other, on either side of the styler head. Other angles between the air flow directions D**3'** and D**4'**, emitted from the roof lifting vents, are also possible.

[0213] Having the root lifting vents **26** oriented at an angle that is not parallel to the plane of the heater plates **20***a*, **20***b*, **22***a*, **22***b* has been found to be beneficial, as when the root lifting air flow is parallel to the heater plates, it has been found to create "fly away" hair strands and reduces alignment of the hair fibres, thus reducing the end result of shine and style longevity. It has therefore been found that an angle of around 45° reduces the creation of "fly away" hair strands, while still providing an angle of flow which makes it easy for the user to create root lift. If the angle is substantially larger than 45°, creating root lift becomes more difficult.

[0214] From the cross-sectional illustration of FIG. **30**, it should also be noted that, in this variant of the head of the styler, the incoming airflow is only along the first airflow conduit **15**, from which it passes (in direction D**2**) through the airflow guide structure **24** and into the inter-arm chamber **13**. Thus, in this variant, the second arm **16** does not comprise a second airflow conduit for delivering air to the head of the styler, but nevertheless includes airflow redirecting channels **28** for receiving some of the air emitted from the first arm **14** and delivered via the airflow guide structure **24** through the inter-arm chamber **13**.

[0215] From the inter-arm chamber **13**, the air is then spread sideways (e.g. by means of angled surfaces **46** incorporated within the second arm **16**) and enters the airflow redirecting channels **28**, from which the air then passes along airflow conduits **19***a*, **19***b*, **21***a* and **21***b* to leave the device via vents **26** in 45° directions D**3'** (via conduits **19***a* and **21***a*) and D**4'** (via conduits **19***b* and **21***b*). As shown in FIG. **30**, airflow conduits **19***a*, **19***b*, **21***a* and **21***b* respectively extend behind the heater plates **20***a*, **20***b*, **22***a* and **22***b* that are mounted on the first and second arms **14**, **16**.

[0216] Further Feature 4—to Reduce Instances of Escaped Air from the Distal Tip of the Styler

[0217] In the embodiments described above, it has been found that, when the styler is closed with hair between the heater plates, it is possible for air to escape from the distal end of the styler, particularly at the end of the heater plates. This has been found to reduce the drying rate, since less air passes through the hair tress, and also to lead to fibre alignment issues.

[0218] However, with reference now to FIGS. **31** and **32**, following further development work this issue of escaped air from the distal tip of the styler has been resolved by providing mutually-opposing spring-loaded non-thermally-conductive (e.g. plastic) sealing elements **48** on both the top and bottom styler arms **14**, **16**, at the distal tip of the device. The sealing element **48** is flat and also stands proud of the adjacent heater plates (e.g. **20***a*, **20***b*) to ensure that, when the heater plates are loaded with hair, the top and bottom sealing elements **48** come together to create a seal which prevents air escaping from the tip of the styler along the heater plates. A spring, by means of which each sealing element **48** is mounted, allows for varying amounts of hair to be placed between the heater plates and for a seal to still be maintained.

[0219] Further Feature 5—to Enable Consistent Performance Around the World

[0220] It is desirable that the styler product should have substantially the same performance wherever it is used around the world, even though mains voltages may vary from country to country. Mains voltage variation particularly impacts the temperature of the heated air within the device, since the air is heated using a standard resistive wire heater, and the electrical power consumed by such a heater and converted to heat is a function of voltage. It is therefore desirable to ensure that the energy transferred to the air is the same, regardless of the location of the device around the world, to ensure that the drying rate is the same and the product does not damage the hair fibre.

[0221] Control of energy transfer to the air can be achieved in various ways—for example, by varying the fan speed (which is undesirable since it affects the amount of airflow), or by using a variable resistor in the heater (which is also undesirable). Another option, which we have found to work well, is to control the temperature of the heater by means of an electrical switching technique, whilst keeping the fan speed constant. For instance, the number of mains cycles across the heater per second may be controlled using a standard zero-crossing switching technique employing triacs, essentially performing pulse width modulation of the electrical power supplied to the heater. In such a manner the thermal output of the heater element, and the device more generally, can be controlled irrespective of variations in local mains voltage.

[0222] Further Feature 6—to Prevent Hot Air from Flowing onto the Hand of the User when the Styler is being Operated

[0223] For the sake of safety and comfort, air should not be able to flow back onto the user's hand, given that the temperature of the air can be in excess of 100°. In internal tests using an early prototype of the styler, it was found that, when styling, it was possible for hot air to escape from the end of the heater plates closest to the handle/hinge, and that this risked causing discomfort to the user.

[0224] To address this issue, and with reference to FIGS. **33** and **34**, a ramp-like airflow deflector feature **50** (also shown in FIG. **32**) has been developed for inclusion at the proximal end (i.e. handle end) of each of a pair of heater plates, i.e. either plates **20***a* and **20***b*, or plates **22***a* and **22***b*, to prevent hot air from escaping backwards towards the user's hand. The ramp-like shape of the deflector **50** is important for two reasons: it stops the air from passing backwards, and does not trap the user's hair during styling. In comparison, a standard "block" form would risk creating pinch points that would pull and trap the user's hair. The ramp design of deflector **50** prevents this from happening, and also redirects the back-flowing air (that would otherwise escape towards the user) towards the opposing arm of the device, to prevent discomfort to the user's hand.

[0225] Further Feature 7—to Avoid the Build-Up of Residual Heat in the Air Heating Components (and Associated Electronics), Particularly at the Time when the Device is Switched from on to Off

[0226] For safety reasons, the styler device will ordinarily contain a thermostat and a thermal fuse, either of which will cause the device to stop working when tripped (or, in the case of the thermal fuse, when blown). The thermostat is resettable and is designed to protect against accidental blockage of the air inlet to the device, or lack of filter cleaning. If the thermostat is tripped, the device can be used again once it has cooled back down.

[0227] However, the thermal fuse blowing is a more permanent issue (requiring the fuse to be replaced), and is designed to protect the device against an uncontrollable catastrophic failure, such as a commutation failure in the triacs driving the air heater. The thermal fuse failing would render the product unusable until the fuse is replaced. Hence, it is not desirable for the fuse to fail during normal and safe use.

[0228] In internal tests using an early prototype of the styler, it was found that, when the unit is switched from on to off (i.e. at the end of a period of use) and the internal fan consequently stops, the temperature of the air heating components in the area of the thermostat and thermal fuse could peak to high temperatures. After a number of cycles of operation and an extended period of time, such temperature peaks could cause either the thermostat to trip or the thermal fuse to blow, particularly in the extreme case of blocked filters. (Also both components have a high variance in activation temperature from the nominal activation temperature, and degrade with age.) Such tripping of the thermostat or blowing of the thermal fuse would cause an undesirable fail in a safe device that is otherwise working normally.

[0229] One way of addressing this is to cause the internal fan to continue to operate in a so-called "ramp-down" mode when the device is switched from on to off. Accordingly, the fan would continue to run for a short period of time to reduce the residual heat in the heating components and associated electronics. That is to say, the fan in ramp-down mode would remove the residual heat from the system by causing the passage of a flow of air over said components.

[0230] However, it was found that, should someone unplug the device rather than simply switch off the product using its on/off switch, the temperature would peak as previously, since the fan would not enter its ramp-down mode.

[0231] With reference to FIG. **35**, this issue has been resolved by providing an initial airflow splitter **52** at the entrance to the heater assembly **44**. The airflow splitter **52** has a generally tapered or conical shape, to direct incoming airflow from the fan towards the heating coils **40** (rather than simply passing along the centre of the heater assembly **44**). By specifically directing the incoming airflow over the heating coils **40** in this manner, this provides more efficient transfer of heat from the coils **40** to the incoming airflow during use. Moreover, since the coils **40** are run more efficiently, with more of the heat being transferred from the coils to the incoming airflow, there is less build-up of heat in the coils (and associated electronics) themselves, thus keeping them generally cooler. As a consequence, when the device is switched from on to off, there is less residual heat in the heating system. Accordingly, even if the fan is suddenly turned off, components such as the thermostat and thermal fuse are exposed to less severe peaks in temperature, such that they do not trip or blow.

[0232] To illustrate this further, FIG. **36** shows plots of internal air temperature over time, in the region of the thermostat (lower line) and the thermal fuse (upper line) within a styler device having an airflow splitter **52**. The plots span the point when the device is switched from on to off and the internal fan stops. It can be seen that, at the point when the device is switched off and the fan stops, a modest thermal spike of about 80° C. is experienced in the vicinity of the thermostat and thermal fuse, reaching a maximum temperature of about 140° C. This thermal spike is within the permitted operating temperatures of those components and causes neither component to trip or blow.

[0233] By way of comparison, FIG. **37** shows corresponding plots of internal air temperature over time, in the region of the thermostat (lower line) and the thermal fuse (upper line) within a test styler device that does not have an airflow splitter **52**. Again, the plots span the point when the device is switched from on to off and the internal fan stops. It can be seen that, at the point when the device is switched off and the fan stops, a more pronounced thermal spike of about 100° C. is experienced in the vicinity of the thermostat and thermal fuse. A maximum temperature of about 160° C. is reached in the vicinity of the thermal fuse, which may in some cases be sufficient to cause this component to blow. Accordingly, such an issue is prevented by the provision of the airflow splitter **52**.

[0234] FIG. **35** also shows the airflow mixer **42** from FIGS. **42-47**, although the airflow mixer **42** and the airflow splitter **52** need not necessarily both be present. However, synergistic advantages can be realised if the airflow mixer **42** and the airflow splitter **52** are both present—i.e. in respect of more efficiently heating the incoming air, and delivering the heated air more evenly to the user's hair.

[0235] Indeed, a well-functioning styler device with numerous synergistic advantages may be obtained by implementing all of the above "further features" **1** to **7** in a single device. However, any of the "further features" **1** to **7** may be omitted if desired. Indeed, none of the "further features" **1** to **7** should be considered essential to the present invention in its broadest sense, the scope of which is defined by the appended claims.

1. An apparatus for drying and styling hair, comprising:
first and second mutually-opposing arms adapted for movement between an open configuration for receiving a length of wet hair therebetween and a closed configuration adjacent the hair, such that, in use, when the arms are in the closed configuration they form an inter-arm chamber across which the hair passes, and wherein an airflow conduit is provided within and along at least one of the first and second arms; and
means for delivering a flow of air along the conduit in the at least one of the first and second arms, and subsequently into the inter-arm chamber.

2. The apparatus according to claim **1**, wherein one or both of the arms further comprises an airflow guide structure arranged to receive the flow of air from the respective conduit and to direct the flow of air from a first direction that is substantially parallel to the length of the respective arm, to a second direction that is from the respective arm towards the opposing arm, into the inter-arm chamber.

3. The apparatus according to claim **2**, wherein each of the first and second arms comprises a respective conduit and a respective airflow guide structure, and the means for delivering the flow of air is arranged to deliver the air along the conduit in each of the first and second arms and thence through the respective airflow guide structure and into the inter-arm chamber.

4. The apparatus according to claim **3**, wherein each airflow guide structure is offset from an imaginary centreline midway between the first and second arms when in the closed configuration.

5. The apparatus according to claim **2**, wherein the conduit in the or each arm acts as a plenum chamber through which the air flows into the respective airflow guide structure and thence into the inter-arm chamber.

6. The apparatus according to claim **5**, wherein the airflow guide structure in the or each arm comprises a cellular structure configured to direct the flow of air from the first direction to the second direction, the cellular structure comprising a plurality of cell walls which extend along the second direction into the respective plenum chamber.

7. The apparatus according to claim **6**, wherein the depth of the cells into the respective plenum chamber progressively increases with distance along the respective arm.

8. The apparatus according to claim **6**, wherein the diameter of the cells progressively decreases with distance along the respective arm.

9. The apparatus according to claim **6**, wherein the cellular structure has a honeycomb structure.

10. The apparatus according to claim **6**, wherein the or each airflow guide structure further comprises a plurality of airflow redirecting channels configured to convey the flow of air from the second direction to third and fourth directions that are outward from the apparatus, substantially perpendicular to the length of the arms.

11. The apparatus according to claim **10**, wherein the airflow redirecting channels extend between longitudinal edges and corresponding longitudinal sides of the airflow guide structure.

12. The apparatus according to claim **1**, further comprising mutually-opposing plates disposed on the first and second arms, the mutually-opposing plates being arranged to come together when the first and second arms are in the closed configuration.

13. The apparatus according to claim **12**, wherein first and second plates are disposed on the first arm, and respective opposing first and second plates are disposed on the second arm.

14. The apparatus according to claim **12**, wherein at least one of said plates comprises means for applying heat to said length of hair in use, when the first and second arms are in the closed configuration.

15. The apparatus according to claim **13**, wherein the or each airflow guide structure further comprises a plurality of airflow redirecting channels configured to convey the flow of air from the second direction to third and fourth directions that are outward from the apparatus, substantially perpendicular to the length of the arms, and further comprising airflow conduits that extend behind the first and second plates of the respective arm, arranged to receive air from said airflow redirecting channels and to direct airflow behind the first plate and outward through vents along the edge of the apparatus in substantially the third direction, and to direct airflow behind the second plate and outward through vents along the edge of the apparatus in substantially the fourth direction.

16. The apparatus according to claim **15**, wherein the airflow guide structure including the cellular structure and the airflow redirecting channels, and the outward vents in the third and fourth directions, are a unitary structure.

17. The apparatus according to claim **15**, wherein the outward vents are oriented at an angle of about 45° relative to the plane of said plates.

18. (canceled)

19. (canceled)

20. The apparatus according to claim **1**, wherein the means for delivering the flow of air comprises a fan.

21.-**24**. (canceled)

25. The apparatus according to claim **1**, further comprising means for heating said airflow.

26. The apparatus according to claim **25**, wherein said means for heating said airflow comprises electrical heating coils.

27. The apparatus according to claim **26**, further comprising an airflow splitter arranged to direct incoming airflow towards said heating coils.

28. The apparatus according to claim **27**, wherein the airflow splitter is tapered or conical in shape.

29. The apparatus according to claim **25**, further comprising means for performing pulse width modulation in respect of electrical power applied to said means for heating said airflow.

30. The apparatus according to claim **25**, further comprising means for causing turbulence in the heated airflow prior to the airflow reaching the inter-arm chamber.

31. (canceled)

32. The apparatus according to claim **30**, wherein the means for causing turbulence comprises an airflow mixing member disposed between said means for heating said airflow and said conduit in the or each arm.

33. (canceled)

34. The apparatus according to claim **25**, wherein the means for heating said airflow comprises the airflow guide structure, the airflow guide structure being formed of a material that generates heat on application of an electric current thereto.

35. (canceled)

36. The apparatus according to claim **1**, further comprising mutually-opposing spring-loaded sealing elements at the distal tip of each of the first and second arms, for preventing the escape of air past said tip.

37. The apparatus according to claim **1**, further comprising at least one airflow deflector on the outer surface of at least one of said arms, shaped and positioned to deflect any rearward-flowing escaping air away from the user's hand.

38. The apparatus according to claim **37**, wherein said airflow deflector is ramp-shaped.

39. A method of drying hair using apparatus according to claim **1**.

40. The method of claim **39**, further comprising using the apparatus to style the hair substantially simultaneously with drying the hair.

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