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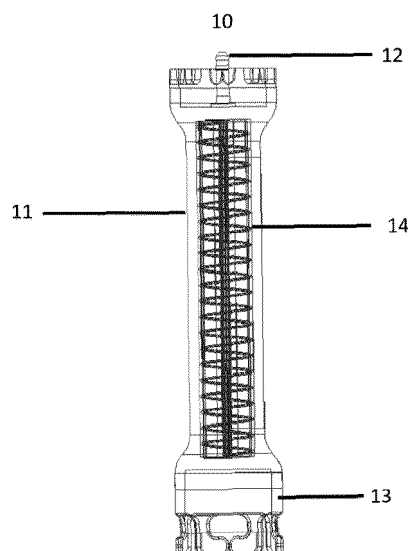
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(54) **INTERLOCKABLE HAIRCURLERS FOR PERMING LONG HAIR**

(57) The present invention is directed to the provision of interlockable hair curlers, an assembly of interlockable hair curlers, treatment processes for reshaping of keratin

fibers using these interlockable hair curlers, and a kit-of-parts. The invention allows for a more homogenous perming result.

Fig. 1



Description**Field of the invention**

5 **[0001]** The present invention is directed to the provision of interlockable hair curlers, an assembly of interlockable hair curlers, treatment processes for reshaping of keratin fibers using these interlockable hair curlers, and a kit-of-parts.

Background of the invention

10 **[0002]** Fashionable people of all societies tend to change their hairstyles according to their personal taste. With this intention, in some regions of the world, processes were developed which do not only reflect local fashion, but also the affinity to technology of the society.

[0003] Permanent waving processes have long been known in the Western world and Asian countries. Especially in countries of South-East Asia, a specific process of permanently waving hair is preferred, namely digital perming services. 15 These services employ a heatable hair curler that is connected to a microprocessor controlled power source for adjusting temperature of the hair curlers, and, thus, the hair itself.

[0004] Long hair customers undergoing reshaping processes of their hair often times are dissatisfied by the way the curling processes worked out. For example, when hair is wound onto curlers, the heat exposure to the hair contacting the rod is much higher in comparison to the hair on the outer layers of the rod, because the hair contacting the curler 20 works as insulating material. This results in an uneven curling of the hair.

[0005] For cold perm processes, EP2301376 and IT242372 disclose connectable perming rods, but they lack the electrical heating means.

[0006] KR20130001874 discloses digital perming curlers having an internal heating system.

25 **Summary of the invention**

[0007] Inventors of the present invention have unexpectedly found out that the hair reshaping results using digital perming services for long-hair customers are more even when hair curlers are connected in longitudinal direction. The type of connections between curlers are removable which allows for wide application of the hair curlers. Thus, they can 30 be used alone or in connection with each other.

[0008] Therefore, the first object of the present invention a hair curler comprising:

- a hollow cylindrical body,
- 35 - electrical heating means for heating the cylindrical body to a surface temperature in the range of 45°C to 150°C,
- a first end configured to connect the electrical heating means to an electrical power source,
- a second end configured to interlock with at least one other mechanical device in longitudinal direction with respect 40 to the cylindrical body,
- wherein the electrical heating means is arranged inside of the cylindrical body, and
- wherein the first end and second end are arranged on opposite sides of the hollow cylindrical body.

45 **[0009]** The hair curler as defined above has the advantage that it is interlockable with at least one other mechanical device in longitudinal direction with respect to the cylindrical body, leading to an extension of surface area onto which the hair of the customer can be wound. By achieving this aspect, it is either possible to achieve a more homogenous perming result, or to conduct two different treatment processes to hair, for example a curling process for the part of the 50 hair that is wound around the heated curler, and another process onto hair wound on the other mechanical device.

[0010] Moreover, the hair curlers are versatile, because the connections are not permanent and may be removed after completion of the hair treatment, for example while storing the hair curlers, or they may be used individually for other customers preferring non-homogenous curling degrees of the hair or having short hair.

55 **[0011]** For maintaining this versatility, it is preferred that the first end and/or second end of the cylindrical body is configured for removable connections.

[0012] From the viewpoint of achieving an even perming result for long-hair customers, it is preferred that the second end of the cylindrical body has a fixing member for removably interlocking to at least one other mechanical device, more preferably to at least one other hair curler, further more preferably configured for removably interlocking to exactly one

other hair curler.

[0013] The most preferred configuration has the advantage that the same treatment processes may be conducted on the same long hair streak while allowing for sufficient surface area onto which the hair can be wound.

[0014] From the viewpoint of usability in the hair salon, it is preferred that the second end is a male or female fixing member. While using the hair curlers in line with this aspect of the present invention, the user then connects a hair curler with male fixing member with another hair curler having a female fixing member. The hair curlers can easily be recognized by their difference in appearance by the user. Moreover, the connection is mechanically stable.

[0015] It is preferred that the male or female fixing member(s) are a plurality of recesses and protrusions around the circumferential line of the second end of the cylindrical body configured to host the plurality of recesses and protrusions of a second mechanical device, preferably a hair curler, to form a stable mechanical connection.

[0016] It is further advantageous from the viewpoint of forming a stable mechanical connection, that male or female fixing members are selected from interlockable bayonet type fixing members or interlockable edges. The most preferred male or female fixing members are interlockable bayonet type fixing members, from the viewpoint of user convenience and stability of mechanical connection.

[0017] The second object of the present invention is a hair curler assembly comprising two removably interlocked hair curlers as defined above.

[0018] It is preferred from the viewpoint of forming a stable mechanical connection that the second ends of the two hair curlers are connected, more preferably they are connected by male or female fixing members selected from interlockable bayonet type fixing members or interlockable edges. The most preferred male or female fixing members are interlockable bayonet type fixing members.

[0019] It is preferred that at the end of the protrusions of the bayonet type fixing members in opposite direction with respect to the hollow cylindrical body a notch is arranged extending into radial direction with respect to the hollow cylindrical body configured to interlock with one other mechanical device, preferably a hair curler. This aspect allows for forming a mechanically stable connection with at least one other device, preferably with another hair curler.

[0020] It is preferred for the protrusions of the interlockable edges in opposite direction to the cylindrical body that they are of quadrangular or triangular shape. These shapes allow for forming a mechanically stable connection with at least one other device, preferably with another hair curler.

[0021] The third object of the present invention is a digital perm machine comprising:

- one or more electrical power source(s),
- one or more control unit(s) for regulating the power of the one or more electrical power source(s),
- one or more hair curler(s) as defined above,
- one or more electrical power cable(s) for connecting the electrical power source(s) to one or more hair curlers as defined above.

[0022] The digital perm machine has the advantage that it is particularly suitable for long-hair customers who desire a shape transformation of their hair.

[0023] The fourth object of the present invention is a permanent reshaping process for keratin fibers, preferably human keratin fibers, more preferably human hair, comprising the steps of:

- a) putting keratin fibers under mechanical tension,
- b) winding keratin fibers onto one or more hair curler(s) as defined above,
- c) applying to keratin fibers a permanent waving composition having a pH in the range of 4 to 12,
- d) heating the keratin fibers by applying electrical power to the hair curler as defined above to a temperature in the range of 45°C to 150°C for a time period in the range of 1 min to 60 min,
- e) optionally allowing the hair curlers to cool down,
- f) removing the keratin fibers from the hair curler(s),
- g) optionally shampooing and/or drying the keratin fibers.

[0024] It is preferred from the viewpoint of homogenously perming the hair of long hair customers that in step b) an interlockable connection of two hair curlers is formed prior to winding hair onto the hair curlers. The interlockable connection may be formed as explained above for the hair curlers.

[0025] In one aspect of the present invention, the permanent waving composition of step c) is a non-reducing, non-oxidizing permanent waving composition comprising one or more alkalizing agent(s) and having a pH in the range of 7 to 12.

[0026] In another aspect of the present invention, the permanent waving composition of step c) is a reducing composition comprising one or more reducing agent(s) and one or more alkalizing agent(s) and having a pH in the range of 4 to 12.

[0027] Another object of the present invention is a kit-of-parts comprising:

- one or more hair curlers as defined above,
- one or more composition(s) selected from:
 - i) non-reducing, non-oxidative permanent waving compositions as defined above,
 - ii) reducing permanent waving compositions as defined above,
 - iii) oxidative compositions having a pH in the range of 1 to 6 and comprising one or more oxidizing agent(s),
- and optionally a digital perm machine as defined above.

Brief description of the figures

[0028]

Fig. 1 depicts a side view of the hair curler of the present invention.

Fig. 2 depicts a side view of the hair curler assembly of the present invention.

Fig. 3A and B depict side views of the second ends of the hair curler of the present invention.

Fig. 4 depicts a digital perm machine of the present invention.

Detailed description of the invention

Hair curler

[0029] The present invention is directed to a hair curler (10) comprising:

- a hollow cylindrical body (11),
- electrical heating means (14) for heating the cylindrical body to a surface temperature in the range of 45°C to 150°C,
- a first end (12) configured to connect the electrical heating means to an electrical power source,
- a second end (13) configured to interlock with at least one other mechanical device in longitudinal direction with respect to the cylindrical body (11),
- wherein the electrical heating means (14) is arranged inside of the cylindrical body, and
- wherein the first end (12) and second end (13) are arranged on opposite sides of the hollow cylindrical body (11).

[0030] Fig. 1 depicts a side view of the hair curler 10 having a hollow cylindrical body 11 enclosing an electrical heating means 14. The first end 12 is configured to connect to an electrical power source whereas the second end 13 is configured to interlock with another device in a longitudinal direction with respect to the hollow cylindrical body 11, preferably with another hair curler.

[0031] It is preferred from the viewpoint of user convenience that the hair curler above is a digital perm hair curler.

[0032] The hollow cylindrical body (11) forms a holder and encloses the electrical heating means (14). Thus, the inner diameter of the cylinder is configured large enough for enclosing the heating means (11). Moreover, the wall thickness of the cylinder may be adjusted based on the material and the necessary mechanical resistance.

[0033] The hollow cylindrical body (11) may further be closed at the first end (12) and/or the second end (13) from the viewpoint of cosmetic and electrical safety. However, the first end (12) must be configured to allow an electrical connection of the electrical heating means (14) to the electrical power source.

[0034] It is preferred from the viewpoint of heat resistance and cosmetic safety of the cylindrical body (11) that it is made of heat-resistant plastic material having a melting point above 200°C, preferably it is made of polyethylene, polypropylene, or other suitable polymers.

[0035] The electrical heating means (14) is located inside of the cylindrical body (11) for heating the cylindrical body (11) to a surface temperature in the range of 45°C to 150°C. Thus, the cylindrical body (11) completely encloses the electrical heating means (14). However, this does not exclude the electrical heating means (14) being physically embedded into the cylindrical body (11).

[0036] As electrical heating means (14) any type of suitable heating means may be employed. Such heating means are, for example, heating coils which heat by electrical resistance, thermoelements, or convections heaters.

[0037] It is essential for the present invention that the electrical heating means (14) is configured to heat the hair curler surface in a temperature range of 45°C to 150°C. The required pre-set temperature of the hair curlers may be set at the digital perm machine that the hair curler is removably and electrically connected to by its first end (12). The pre-set temperature is then transformed into an electrical power output from the digital perm machine.

[0038] The second end (13) of the hair curler is configured to interlock with at least one other mechanical device in longitudinal direction with respect to the cylindrical body (11).

[0039] It is preferred from the viewpoint of usability that the second end (13) of the cylindrical body has a fixing member for removably interlocking to at least one other mechanical device, preferably to at least one other hair curler, more preferably configured for removably interlocking to one other hair curler.

[0040] It is further preferred from the viewpoint of usability that the second end (13) is a male and/or female fixing member.

[0041] The present invention is also directed to fixing members that are male-male type or male-female type as long as they are able to stably interlock from the mechanical point of view the hair curlers allowing for a removable connection.

[0042] It is preferred that the male or female fixing member(s) are a plurality of recesses and protrusions around the circumferential line at the second end (13) of the cylindrical body (11) configured to host the plurality of recesses and protrusions of a second mechanical device, preferably a hair curler, to form a stable mechanical connection.

[0043] It is preferred from the viewpoint of forming a stable mechanical connection that the second ends of the two hair curlers are connected, more preferably they are connected by male or female fixing members selected from interlockable bayonet type fixing members or interlockable edges.

[0044] Fig. 3B depicts a side view of the second end 13 of the hair curlers. The removably interlockable end is achieved by a fixing member with a edge mechanism.

[0045] Among those interlockable fixing members above, the interlockable edges as displayed in Fig. 3B are most preferred from the viewpoint of manufacturing and user convenience.

[0046] The interlockable edges at the second end (13) of the hair curlers are a plurality of recesses and protrusions around the circumferential line of the cylindrical body (11). The plurality of recesses and protrusions extend in longitudinal direction with respect to the cylindrical body (11). The ends of the protrusions opposite to the cylindrical body (11) preferably are quadrangular or triangular from the viewpoint of forming a stable mechanical connection with one other device, but may have other angles allowing for an interlocking mechanism. Thus, the hair curler of the present invention (10) and the second mechanical device both have a plurality of recesses and protrusion arranged at their second ends (13). This configuration allows an interlocking of protrusions of a second mechanical device, preferably a hair curler, with the recesses of the first hair curler (10) for forming a mechanically stable connection. Simultaneously, the recesses of the second mechanical device, preferably a hair curler, interlock with the protrusions of the first hair curler (10). For achieving this interlocking by edges, the protrusions and recesses of the second mechanical device, preferably a hair curler, possess the geometric dimension to fit into the protrusions and recesses of the first hair curler (10).

[0047] Fig. 3A depicts a side view of the second end 13 of the hair curlers. The removably interlockable end is achieved by a fixing member with a bayonet-type mechanism.

[0048] Among those interlockable fixing members above, the interlockable bayonet type fixing members as displayed in Fig. 3A are most preferred from the viewpoint of user convenience and stability of mechanical connection between the hair curler (10) and another mechanical device, preferably another hair curler.

[0049] The interlockable bayonet type fixing members at the second end (13) of the hair curlers are arranged at the circumferential line of the hollow cylindrical body (11) and are a plurality of protrusions extending in longitudinal direction with respect to the hollow cylindrical body (11). At the end of each protrusion in opposite direction to the hollow cylindrical body, a notch is arranged extending into radial direction with respect to the hollow cylindrical body (11). Thus, a stable

mechanical connection is formed when the hair curler (10) of the present invention is connected to another mechanical device, preferably a hair curler, having a similar, preferably the same, bayonet configuration at one of its ends, preferably at the second end. The interlocking is initiated by sticking the hair curler (10) with the other mechanical device together to allow the tip of the notches to touch the circumferential line of the hollow cylindrical body (11), and then turning the devices in opposite directions to interlock the hair curler (10) with the other mechanical device, preferably with another hair curler. For achieving this interlocking by bayonets, the bayonets of the second mechanical device, preferably a hair curler, possess the geometric dimensions to fit into the bayonets of the first hair curler (10).

Hair curler assembly

[0050] The present invention is also directed to a hair curler assembly (20, 30) comprising two removably interlocked hair curlers as defined above.

[0051] Fig. 2 depicts a side view of the hair curler assembly 20 comprising two removably interlocked hair curlers 10 by edges. The hair curlers are interlocked at their second ends 13.

[0052] The hair curlers (10) are interlocked to form the assembly (20).

[0053] The interlockable connection of the hair curler assembly (20, 30) provides for sufficient mechanical stability to allow for hair wrapping around the hair curler assembly (20, 30) and attaching said assembly to the hair for reshaping process treatment. Exemplified suitable connections are disclosed above for the hair curler (10).

Digital perm machine

[0054] The present invention is also directed to a digital perm machine comprising (50):

- one or more electrical power source(s) (51),
- one or more control unit(s) (52) for regulating the power of the one or more electrical power source(s),
- one or more hair curler(s) (53) as defined above,
- one or more electrical power cable(s) (54) for connecting the electrical power source(s) to one or more hair curlers as defined above.

[0055] Fig. 4 depicts a digital perm machine 50 comprising an electrical power source 51, a control unit 52 for regulating the power of the electrical power source(s), hair curlers 53 being connected by electrical power cables 54 to the electrical power source.

[0056] The electrical power source (51) preferably allows for modulation of power output to the hair curler(s) defined above. By power modulation, the heating temperature and heating program may be set. It is further preferred that the electrical power sources comprises a transformer for transforming household AC power to low-voltage DC power that may be used for heating the hair curlers (53)

[0057] The control unit (52) regulates the power output of the one or more electrical power source(s) (51). Preferably, the control unit (52) is a microprocessor controlled device configured to regulate the power of one or more electrical power source(s). The microprocessor device allows for easy configuration by the user and translates user input such as temperature and time into power output of the one or more power source(s) (51).

[0058] It is further preferred that each hair curler (53) is connected with a separate power cable(s) (54) to the electrical power source(s). This allows for an electrically safe operation of the digital perm machine.

[0059] In one aspect of the present invention, the hair curler (53) as defined above is directly connected to another hair curler (53) to form an assembly. Then both of the hair curlers are electrically connected by power cables (54) to the power sources. It is preferred that a plurality of hair curler assemblies are connected to one power source (51).

[0060] In another aspect of the present invention, the hair curler as defined above is connected to the connector as defined above which then connects to another hair curler. Suitably, both hair curlers are then electrically connected to the power source by power cables (54). It is preferred that a plurality of hair curler assemblies are connected to one power source (51).

Process for reshaping hair

[0061] The present invention is also directed to a permanent reshaping process for keratin fibers, preferably human keratin fibers, more preferably human hair, comprising the steps of:

a) putting keratin fibers under mechanical tension,

b) winding keratin fibers onto a hair curler as defined above,

c) applying to keratin fibers a permanent waving composition having a pH in the range of 4 to 12,

d) heating the keratin fibers by applying electrical power to the hair curler as defined above to a temperature in the range of 45°C to 150°C for a time period in the range of 1 min to 60 min,

e) optionally allowing the hair curlers to cool down,

f) removing the keratin fibers from the hair curler(s),

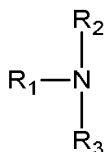
g) optionally shampooing and/or drying the keratin fibers.

[0062] It is preferred for long hair customers that in step b) an interlockable connection of two hair curlers is formed prior to winding hair onto the hair curlers.

Non-reducing, non-oxidizing permanent waving

[0063] In one aspect of the present invention, the permanent waving composition of step c) is a non-reducing, non-oxidizing permanent waving composition comprising one or more alkalizing agent(s). Preferably, the composition has a pH in the range of 7 to 12, more preferably in the range of 8 to 11.

[0064] Suitably, the alkalizing agent of non-reducing, non-oxidizing permanent waving composition is selected from ammonia and/or its salt(s), guanidine and/or its salt(s), and/or organic alkyl and/or alkanol amines according to the general structure



wherein R₁, R₂, and R₃ are independently selected from H, linear C₁-C₆ alkyl which may be substituted with one hydroxyl group, or branched C₃-C₁₂ alkyl or alkanol, wherein at least one of R₁, R₂, or R₃ is different from H, and/or their salts.

[0065] The organic alkyl and/or alkanol amine according to the structure above may be selected from mono- and/or diethanolamine, butyl ethanolamine, butyl diethanolamine, dibutyl ethanolamine, methylethanolamine, triethanolamine, N-lauryl diethanolamine, diisopropanolamine, dimethyl isopropanolamine, isopropanolamine, triisopropanolamine, isobutanolamine, tris-(hydroxymethyl)-aminomethane, and/or aminomethyl propanol. Equally suitable are salts of alkyl and/or alkanol amines with a counterion preferably selected from chloride and/or hydrogen chloride, nitrate, sulphate, phosphate, hydrogenphosphate, dihydrogenphosphate, citrate, acetate, sulphite, benzoate, salicylate.

[0066] In one aspect of the present invention, the alkalizing agent of the non-reducing, non-oxidizing permanent waving composition is selected from aminomethyl propanol and/or monoethanolamine, and/or diethanolamine, and/or tris-(hydroxymethyl)-aminomethane, and/or their salts.

[0067] In another aspect of the present invention, the alkalizing agent of the non-reducing, non-oxidizing permanent waving composition is ammonia and/or its salts.

[0068] In yet another aspect of the present invention, the non-reducing, non-oxidizing permanent waving composition comprises at least 2 different alkalizing agents. The first alkalizing agent of the alkaline composition of step b) is selected from ammonia and/or its salt(s) and the second alkalizing agent is selected from aminomethyl propanol and/or monoethanolamine, and/or diethanolamine, and/or their salts.

[0069] In a most preferred aspect of the present invention the alkalizing agent is a mixture of one or more alkyl amine(s) and/or their salt(s) with ammonia and/or its salt(s). A preferred combination is, for example, monoethanolamine and/or its salt(s) and ammonia and/or its salt(s). Another preferred combination is aminomethyl propanol and/or its salt(s) and ammonia and/or its salt(s). The aforementioned combinations are preferred from the viewpoint of reducing ammonia smell while maintaining good curling performance, and minimal hair damage.

[0070] Preferably, the total concentration of alkalizing agent(s) of non-reducing, non-oxidizing permanent waving composition is in the range of 0.1% to 10% by weight, more preferably in the range of 0.25% to 7.5% by weight, further

more preferably in the range of 0.5% to 5% by weight, calculated to the total of the composition.

[0071] For attaining the above mentioned effects, the preferred total concentration of alkalizing agent(s) in the non-reducing, non-oxidizing permanent waving composition is in the range of 0.1% to 10% by weight, preferably in the range of 0.25% to 7.5% by weight, more preferably in the range of 0.5% to 5% by weight, calculated to the total of the composition of step b).

[0072] When ammonia is used as alkalizing agent of the non-reducing, non-oxidizing permanent waving composition, the ammonium salts for buffering the composition of step b) may be used, preferably selected from inorganic and/or organic ammonium salts.

[0073] Suitable inorganic ammonium salts are preferably selected from ammonium chloride, ammonium sulfate, ammonium carbonate, ammonium hydrogen carbonate, ammonium phosphates, ammonium hydrogen phosphates, ammonium dihydrogen phosphates, ammonium nitrate, ammonium bromide, ammonium iodide, ammonium thiosulfate, ammonium molybdate, ammonium vanadate, and/or their mixtures.

[0074] Suitable organic ammonium salts are preferably selected from ammonium carbamate, ammonium sulfamate, ammonium citrate, ammonium salicylate, ammonium valerate, ammonium tartarate, ammonium benzoate, ammonium acetate, ammonium formate, and ammonium lactate, ammonium salts of polymers, and/or their mixtures.

[0075] Preferably, the weight ratio of ammonia to ammonium salt(s) in the non-reducing, non-oxidizing permanent waving composition is in the range of 10 to 1.

[0076] The heating temperature of step d) preferably is in the range of 60°C to 120°C from the viewpoint of curling intensity and cosmetic safety. Furthermore, the time period for heating of step d) preferably is in the range of 5 min to 45 min, more preferably in the range of 10 min to 35 min.

Reducing permanent waving

[0077] In another aspect of the present invention, the permanent waving composition of step c) is a reducing composition comprising one or more reducing agent(s) and one or more alkalizing agent(s). Preferably, the composition has a pH in the range of 4 to 12, preferably in the range of 7 to 11, more preferably in the range of 8 to 10.

[0078] The alkalizing agents may be similar to the ones disclosed above for the non-reducing, non-oxidizing permanent waving composition.

[0079] The reducing permanent waving composition comprises one or more reducing agent(s). In principle, any inorganic or organic reducing agent and/or their mixtures are suitable for the purpose of the present invention.

[0080] Suitable inorganic reducing agents are sulfite and/or hydrogen sulfite salts such as sodium, potassium, and ammonium salts. Suitable organic reducing agents are thioglycolic acid and/or its salts, cysteamine and/or its salts, thioglycerin and/or its salts, glycerin esters of thioglycolic acid and/or its salts, thiolactic acid and/or its salts, cysteine or its derivatives and/or its salts, and/or their mixtures. Preferred are thioglycolic acid and/or its salts, thiolactic acid and/or its salts, cysteine or its derivatives and/or its salts and sodium, potassium, ammonium sulfites and their mixtures, from the viewpoint of cosmetic safety. The most preferred reducing agents are thioglycolic acid and/or its salts and sodium, potassium, ammonium sulfites, and/or their mixtures, from the viewpoint of cosmetic safety.

[0081] It is preferred that the total concentration of reducing agents in the reducing permanent waving composition is in the range of 0.5% to 20% by weight, more preferably 1% to 15% by weight, still more preferably 2% to 12% by weight, and still more preferably 3% to 10% by weight, calculated to the total weight of the reducing permanent waving composition.

[0082] It is further preferred that after the application of reducing permanent waving compositions, prior to step f) an aqueous oxidizing composition having a pH in the range of 1 to 6 is applied to keratin fibers for a time period in the range of 1 min to 45 min. The aqueous oxidizing composition comprises one or more oxidizing agent(s), preferably selected from sodium bromate and/or hydrogen peroxide. Suitable concentration ranges for oxidizing agent(s) are in the range of 1% to 12%, calculated to the total weight of the aqueous oxidizing composition.

[0083] Heating times and heating temperatures are as disclosed for the non-oxidizing, non-reducing composition above.

Kit-of-parts

[0084] The present invention is also directed to a kit-of-parts comprising:

- one or more hair curlers as defined above, and

- optionally one or more composition(s) selected from:

- i) a non-reducing, non-oxidative permanent waving composition comprising one or more alkalizing agent(s)

and having a pH in the range of 7 to 12,

ii) a reducing permanent waving compositions comprising one or more reducing agent(s), and or more alkalizing agent(s), and having a pH in the range of 4 to 12,

iii) an oxidative composition having a pH in the range of 1 to 6 and comprising one or more oxidizing agent(s),

- and optionally a digital perm machine as defined above.

[0085] This kit-of-parts is useful in hair salon applications as it allows for direct treatment of clients.

EXAMPLES

Example 1

[0086] Caucasian hair streaks (21 cm long, 2 g per bundle) were purchased from Fischbach + Miller Haar, Laupheim, Germany. The hair curler of Fig. 1 was prepared by 3D printing (12 cm long) and a conventional electrical heating was inserted into the curler.

[0087] Hair was wound onto the curler assembly as depicted in Fig. 2 or on a single curler as depicted in Fig. 1 for comparative testing. Then 2 g of the following composition was applied to both curlers:

	% by weight
Ammonia (28%)	10.0
Propylene glycol	5.0
Ammonium sulfate	2.0
NaOH/HCl	ad pH 9.5
Water	ad 100.0

[0088] The curlers were then electrically connected to a digital perm machine and the curlers were heating for 30 min at 90°C. After the heating step, the curlers were allowed to cool down and removed from the hair streaks. The hair streaks were then washed with lukewarm water, shampooed, and blow dried.

[0089] Assessment of curling efficiency was investigated by measuring and calculating the curl ratio L according to the formula:

$$L = (L_0 - L_t) / L_0$$

wherein L_0 is the length of the hair streak prior to curling and L_t is the length of the hair streak after the curling experiment. The number is reported as percentage and a higher percentage corresponds to higher curling degree.

[0090] The table below reports the experimental results:

Parameter	2 curlers as of Fig. 2	1 curler as of Fig. 1
Curl ratio	18.4	11.3

[0091] As a result it was found that connecting 2 curlers strongly improved curling ratios.

Claims

1. A hair curler (10) comprising:

- a hollow cylindrical body (11),
- electrical heating means (14) for heating the cylindrical body to a surface temperature in the range of 45°C to 150°C,
- a first end (12) configured to connect the electrical heating means to an electrical power source,

- a second end (13) configured to interlock with at least one other mechanical device in longitudinal direction with respect to the cylindrical body (11),
- wherein the electrical heating means (14) is arranged inside of the cylindrical body, and
- wherein the first end (12) and second end (13) are arranged on opposite sides of the hollow cylindrical body (11).

2. The hair curler according to claim 1 **characterized in that** the first end (12) and/or second end (13) of the cylindrical body is configured for removable connections.
3. The hair curler according to claims 1 and/or 2 **characterized in that** the second end (13) of the cylindrical body has a fixing member for removably interlocking to at least one other mechanical device, preferably to at least one other hair curler, more preferably configured for removably interlocking to exactly one other hair curler.
4. The hair curler according to any of the preceding claims **characterized in that** the second end (13) is a male or female fixing member.
5. The hair curler according to any of the preceding claims **characterized in that** the male or female fixing member(s) are a plurality of recesses and protrusions around the circumferential line at the second end (13) of the cylindrical body (11) configured to host a plurality of recesses and protrusions of a second mechanical device, preferably a hair curler, to form a stable mechanical connection.
6. The hair curler according to any of the preceding claims **characterized in that** the male or female fixing member are selected from interlockable bayonet type fixing members or interlockable edges.
7. The hair curler according to any of the preceding claims **characterized in that** at the end of the protrusions of the bayonet type fixing members in opposite direction with respect to the hollow cylindrical body (11) a notch is arranged extending into radial direction with respect to the hollow cylindrical body (11) configured to interlock with one other mechanical device, preferably a hair curler.
8. The hair curler according to any of the claims 1 to 6 **characterized in that** the ends of the protrusions of the interlockable edges in opposite direction to the cylindrical body (11) are of quadrangular or triangular shape.
9. The hair curler according to any of the preceding claims **characterized in that** the cylindrical body (11) is made of heat-resistant plastic material having a melting point above 200°C, preferably it is made of polyethylene or polypropylene.
10. The hair curler according to any of the preceding claims **characterized in that** it is a digital perm hair curler.
11. A hair curler assembly (20) comprising two removably interlocked hair curlers as defined in the claims 1 to 10.
12. A digital perm machine comprising (50):
 - one or more electrical power source(s) (51),
 - one or more control unit(s) (52) for regulating the power of the one or more electrical power source(s),
 - one or more hair curler(s) (53) as defined in the claims 1 to 10,
 - one or more electrical power cable(s) (54) for connecting the electrical power source(s) to one or more hair curlers as defined in the claims 1 to 10.
13. A permanent reshaping process for keratin fibers, preferably human keratin fibers, more preferably human hair, comprising the steps of:
 - a) putting keratin fibers under mechanical tension,
 - b) winding keratin fibers onto one or more hair curler(s) as defined in the claims 1 to 10,
 - c) applying to keratin fibers a permanent waving composition having a pH in the range of 4 to 12,
 - d) heating the keratin fibers by applying electrical power to the hair curler as defined in the claims 1 to 10 to a temperature in the range of 45°C to 150°C for a time period in the range of 1 min to 60 min,
 - e) optionally allowing the hair curlers to cool down,
 - f) removing the keratin fibers from the hair curler(s),
 - g) optionally shampooing and/or drying the keratin fibers.

14. The process according to claim 13 **characterized in that** in step b) an interlockable connection of two hair curlers is formed prior to winding hair onto the hair curlers.

15. A kit-of-parts comprising:

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- one or more hair curlers as defined in the claims 1 to 10, and
- optionally one or more composition(s) selected from:

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- i) a non-reducing, non-oxidative permanent waving composition comprising one or more alkalizing agent(s) and having a pH in the range of 7 to 12,
- ii) a reducing permanent waving compositions comprising one or more reducing agent(s), and or more alkalizing agent(s), and having a pH in the range of 4 to 12,
- iii) an oxidative composition having a pH in the range of 1 to 6 and comprising one or more oxidizing agent(s),

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- and optionally a digital perm machine as defined in claim 12.

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Fig. 1

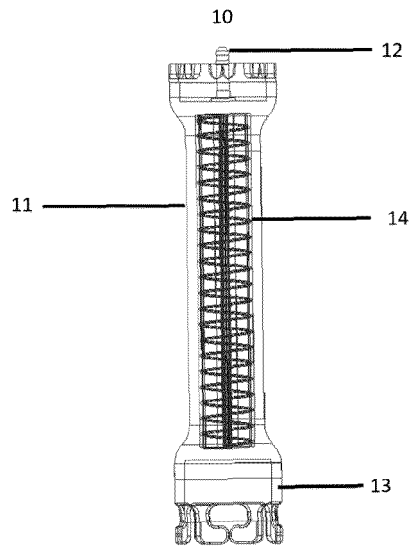


Fig. 2

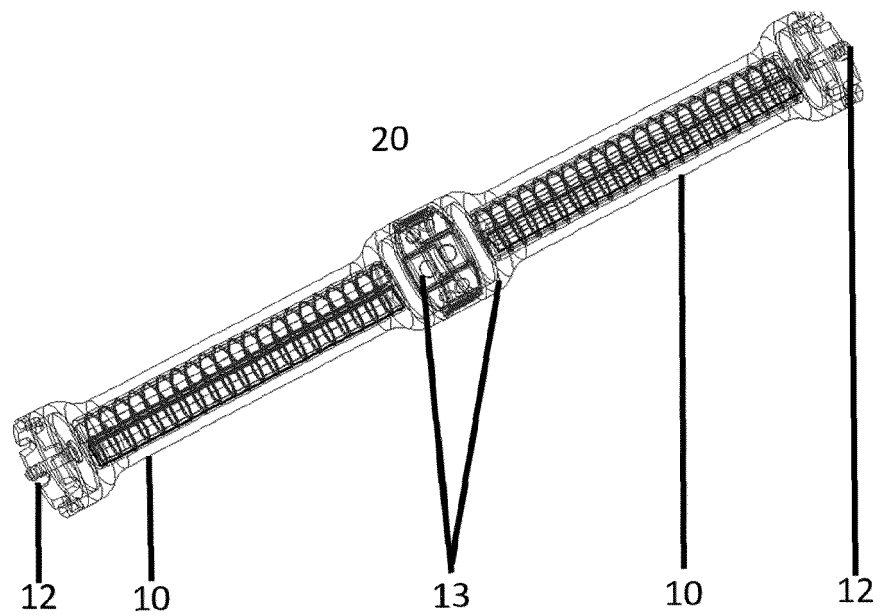


Fig. 3

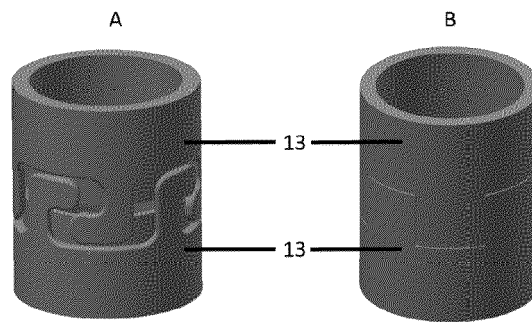
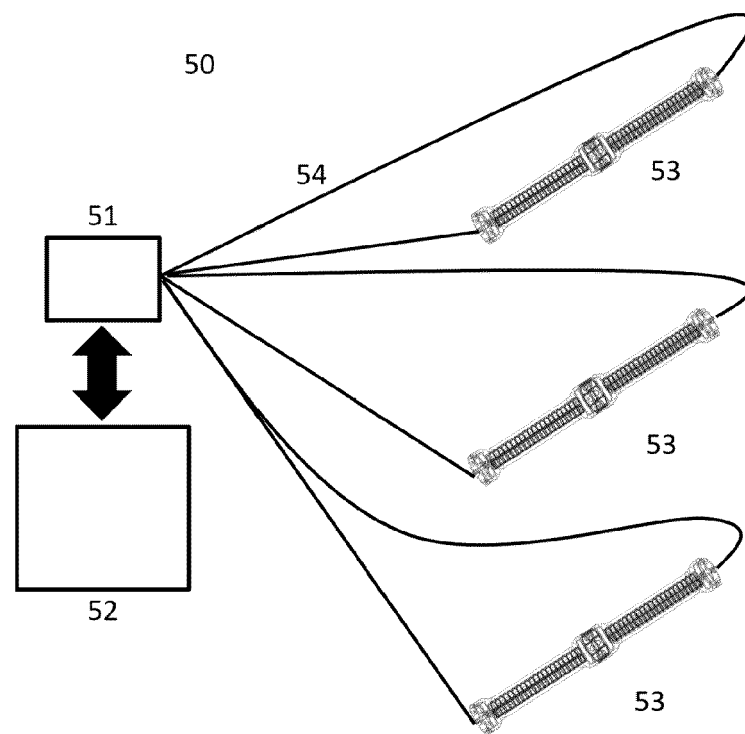


Fig. 4





EUROPEAN SEARCH REPORT

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The Hague		24 July 2020	Zetzsche, Brigitta
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