

DESCRIPTION

TITLE OF INVENTION: HAIR IRON

TECHNICAL FIELD

[0001]

The present invention relates to a hair iron.

BACKGROUND ART

[0002]

Conventionally, a hair iron used for arranging a hairstyle has been known. For example, a hair iron described in Patent Literature 1 below includes a pair of iron pieces coupled in an openable and closable manner. A user arranges the hairstyle by applying heat to hair with the hair sandwiched between the pair of iron pieces.

CITATION LIST

PATENT LITERATURE

[0003]

Patent Literature 1: JP-A-2020-150999

SUMMARY OF INVENTION

PROBLEMS TO BE SOLVED BY INVENTION

[0004]

For the hair iron as described above, there has been a demand for favorable arrangement of the hairstyle without damaging the hair.

[0005]

The present invention has been made in view of the above-described circumstances, and an object of the present invention is to provide a hair iron capable of favorably arranging a hairstyle without damaging hair.

SOLUTION TO PROBLEMS

[0006]

The hair iron of the present invention includes an arm extending from a base end portion, the arm has a plate long in a direction of extending the arm and an elastic member that supports the back side of the plate, and the elastic member has non-linear elasticity with which the elastic member is more easily compressed when a load from a fore side to the back side of the plate is small than when the load is great.

EFFECTS OF INVENTION

[0007]

According to the present invention, since the plate is displaced with small force, the plate can be easily brought into uniform contact with hair. Thus, the plate does not need to be strongly pressed against hair so that the hairstyle can be favorably arranged without damaging the hair.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

Fig. 1 is a perspective view showing a hair iron according to the present embodiment;

Fig. 2 is a longitudinal sectional view showing the hair iron in an open state;

Fig. 3 is a partially-enlarged perspective view showing the vicinity of a switch;

Fig. 4 is an enlarged longitudinal sectional view showing part of a base end portion in a locked state;

Fig. 5 is an enlarged horizontal sectional view showing part of the base end portion in a state of a lock member being arranged at a lock position;

Fig. 6 is an enlarged horizontal sectional view showing part of the base end portion in a state of the lock member being arranged at a unlock position;

Fig. 7 is a partially-cutout perspective view showing a lock in the locked state;

Fig. 8 is a partially-cutout perspective view showing the lock in an unlocked state;

Fig. 9 is a longitudinal sectional view showing a holder of an upper side arm;

Fig. 10 is a plan view showing the holder of the upper side arm from the lower side;

Fig. 11 is an exploded perspective view showing the holder of the upper side arm;

Fig. 12 is a flowchart showing processing in a case where a power supply device is connected to the hair iron;

Fig. 13 is a table showing the configuration of a conical coil spring of each comparative example;

Fig. 14 is a view showing the configuration of the conical coil spring of each comparative example;

Fig. 15 is a table showing calculation results of a load on the conical coil spring of each comparative example and deflection of the conical coil spring of each comparative example; and

Fig. 16 is a graph showing a load-deflection curve of the conical coil spring of each comparative example.

DESCRIPTION OF EMBODIMENTS

[0009]

Preferred embodiments of the present invention will be described below.

[0010]

In the hair iron of the present invention, the elastic member may support the plate at two or more locations in the extending direction. According to this configuration, since the entire plate is supported in a well-balanced manner, the entire plate can be easily uniformly brought into contact with hair.

[0011]

In the hair iron of the present invention, the elastic member may be a conical coil spring.

[0012]

In the hair iron of the present invention, the arm may include a surface plate, a carbon-containing heat conduction layer expanding along a back surface of the surface plate, and a heating element arranged on the back side of the carbon-containing heat conduction layer. According to this configuration, since the heat of the heating element is transferred in a plane direction of the surface plate by the carbon-containing heat conduction layer, it is easy to make the temperature of the surface plate uniform. Further, since far infrared rays are generated by the carbon-containing heat conduction layer, it is possible to heat up to a deep part of hair while reducing thermal damage on the surface of the hair. Thus, the hairstyle can be favorably arranged without damaging the hair.

[0013]

In the hair iron of the present invention, the carbon-containing heat conduction

layer may include a graphite sheet. According to this configuration, the carbon-containing heat conduction layer can be decreased in thickness, and the hair iron can be decreased in size. In addition, since the surface temperature of the surface plate can be made uniform, unevenness of protein denaturation of hair due to a local temperature increase can be made less likely to occur.

[0014]

In the hair iron of the present invention, the carbon-containing heat conduction layer may have flexibility. According to this configuration, since the carbon-containing heat conduction layer is not cracked, the carbon-containing heat conduction layer can be easily handled.

[0015]

In the hair iron of the present invention, the heating element may include a film heater. According to this configuration, the heating element can be decreased in thickness, and the arm can be decreased in size. The heat of the film heater expands in the plane direction from the heater wire by the carbon-containing heat conduction layer. Thus, the temperature of the surface plate can be made uniform in the plane direction while the arm is decreased in size.

[0016]

The hair iron of the present invention has a battery housing that houses a battery, and is operated with power from the battery. According to this configuration, since the hair iron can be used in a place without an outlet, the hair iron can be easily used as a portable device.

[0017]

The hair iron of the present invention may have a socket for a USB cable, be freely connectable to a power supply device via the USB cable, and be operated with

power from the power supply device when the output of the power supply device is higher than a predetermined value, and be operated with the power from the battery when the output of the power supply device is lower than the predetermined value. According to this configuration, in a case where the power supply device having the output higher than the predetermined value is connected, the hair iron is operated with the power from the power supply device, so that it is possible to prolong the life of the battery and use the hair iron even if the battery is not charged. In a case where the power supply device having the output lower than the predetermined value is connected, the hair iron is operated with the power from the battery, so that it is possible to prevent performance degradation due to insufficient output.

[0018]

<Embodiments>

Hereinafter, one embodiment embodying the present invention will be described in detail with reference to Figs. 1 to 16. A hair iron 10 in the present embodiment is used for arranging a hairstyle. The hair iron 10 is a straight iron, and has a pair of arms 13A, 13B coupled at a base end portion 12 as shown in Fig. 1. The pair of arms 13A, 13B of the hair iron 10 opens and sandwiches hair therebetween, and the hair iron 10 applies heat to the hair to arrange the hairstyle. When the hair iron 10 is not used, the pair of arms 13A, 13B is closed.

[0019]

Hereinafter, in the hair iron 10, a state in which the pair of arms 13A, 13B is opened will be referred to as an open state, and a state in which the pair of arms 13A, 13B is closed will be referred to as a closed state. In description of each component, the positive direction side of a Y axis in Fig. 1 (side on which a display 14 is provided) will be referred to as an upper side, the negative direction side of the Y axis in Fig. 1

will be referred to as a lower side, the positive direction side of an X axis (tip end side of the arms 13A, 13B) will be referred to as a front side, and the negative direction side of the X axis (side on which the base end portion 12 is provided) will be referred to as a rear side. The X-axis direction indicates a front-rear direction or a length direction, the Y-axis direction indicates an up-down direction or a thickness direction, and a Z-axis direction indicates a left-right direction or a width direction. In description of each of the arms 13A, 13B, a side on which the pair of arms 13A, 13B face each other will be defined as an inner side or a fore side, and a side opposite to the side on which the arms 13A, 13B face each other will be defined as an outer side or a back side.

[0020]

The display 14 is provided on an outer surface of the upper side arm 13A. The display 14 has, for example, an LED. The display 14 indicates ON/OFF of a power supply, a set temperature, a charge state, etc.

[0021]

The hair iron 10 includes a holder 15 that holds hair and a grip 16 that is gripped by a user. The holder 15 is a front portion of the hair iron 10. The grip 16 is a rear portion of the hair iron 10. In the closed state, the length dimension, width dimension, and thickness dimension of the holder 15 are smaller than the length dimension, width dimension, and thickness dimension of the grip 16.

[0022]

The hair iron 10 includes a cap case 17. The cap case 17 covers the holder 15 in the closed state from the front.

[0023]

The hair iron 10 includes comb-shaped portions 18. The comb-shaped portions 18 are provided on both the left and right sides of the holder 15. The comb-

shaped portions 18 are formed along the substantially entire length of the holder 15 at both the left and right edges of a housing 24 to be described later (see Fig. 10). The comb-shaped portion 18 has a plurality of protrusions 19 arranged in the front-rear direction. Each protrusion 19 has a triangular shape with a pointed protruding end, and the protrusions 19 are arranged at equal intervals. With the comb-shaped portions 18, the surface area of the housing 24 can be increased, heat can be efficiently dissipated, and the temperature of the housing 24 can be easily decreased.

[0024]

The hair iron 10 has a socket 22 for a USB cable 21. The socket 22 is applicable to a USB Type-C. The socket 22 is provided at the base end portion 12 of the upper side arm 13A, and is open to the rear side. The hair iron 10 is connected to a not-shown power supply device via the USB cable 21. A power supply device in accordance with a USB power delivery (PD) standard can be used.

[0025]

As shown in Fig. 2, the pair of arms 13A, 13B is freely displaceable between the open state and the closed state about a hinge 23 provided at the base end portion 12. Fig. 2 shows the hair iron 10 in the open state. Each of the pair of arms 13A, 13B linearly extends forward from the base end portion 12.

[0026]

Each of the arms 13A, 13B includes the housing 24 long in the front-rear direction. The housing 24 houses components forming the hair iron 10. As shown in Fig. 7, the cross section of the housing 24 is curved in an arc shape. Both the left and right edges of the housing 24 are positioned on the fore side with respect to a center portion of the housing 24 in the left-right direction.

[0027]

As shown in Fig. 2, the housing 24 has a battery housing 26 that houses a battery 25. The battery 25 is a rechargeable secondary battery such as a lithium ion battery. The battery 25 is charged by connecting the power supply device via the USB cable 21. The hair iron 10 is operated by electric power supplied from the battery 25.

[0028]

The battery housing 26 is provided in the grip 16 of the lower side arm 13B. The fore side of the battery housing 26 is closed with a battery cover 27. The battery cover 27 is detachable. The battery 25 in the battery housing 26 can be taken in and out by detaching the battery cover 27.

[0029]

As shown in Fig. 3, the hair iron 10 includes a switch 28 that switches ON/OFF of the power supply and the set temperature of a heating element 44 to be described later. The switch 28 is provided at the inner surface of the upper side arm 13A. Since the switch 28 is provided at the inner surface of the upper side arm 13A, it is possible to prevent erroneous operation as compared to a case where the switch 28 is provided at the outer surface. The switch 28 is slidable in the front-rear direction. The power-OFF position of the switch 28 is on the rear side with respect to a power-ON position. Fig. 3 shows the switch 28 at the power-ON position. When the cap case 17 is placed over the holder 15, the switch 28 at the power-ON position is pushed to the rear side by a pressing portion 17A provided at the cap case 17, and moves to a power-OFF position.

[0030]

As shown in Fig. 4, the base end portion 12 has a lock 30 that holds the pair of arms 13A, 13B in the closed state. The lock 30 has a first lock 31 provided on the upper side and a second lock 32 provided on the lower side. The first lock 31 and the

second lock 32 come into contact with each other when the pair of arms 13A, 13B is about to be displaced from the closed state to the open state, and restrain further displacement.

[0031]

The first lock 31 protrudes downward from the housing 24 of the upper side arm 13A.

[0032]

The second lock 32 is provided at a lock member 33 held by the lower side arm 13B. The lock member 33 swings left and right between a lock position (see Fig. 5) and an unlock position (see Fig. 6) about a rotary shaft 33A. In Figs. 5 and 6, a line obtained by projecting the first lock 31 downward is indicated by an imaginary line.

[0033]

As shown in Fig. 4, the lock member 33 includes a main body 34 and an operation part 35. The main body 34 has a plate shape. The second lock 32 protrudes upward from the main body 34. The main body 34 has a lock holder 36 that holds the position of the lock member 33. The lock holder 36 is a recess formed in the back surface of the main body 34. The lock holder 36 is fitted onto a protrusion 37 provided at the lower side arm 13B. The protrusion 37 is elastically displaced in the up-down direction by a spring member 38. The elastic force of the spring member 38 acts in a direction of moving the protrusion 37 upward.

[0034]

The lock holder 36 includes a pair of lock holders 36 provided left and right. As shown in Fig. 5, the lock member 33 is held at the lock position by the left lock holder 36 being fitted onto the protrusion 37. As shown in Fig. 6, the lock member 33 is held at the unlock position by the right lock holder 36 being fitted onto the protrusion

37.

[0035]

The operation part 35 is provided so as to protrude from the rear surface of the main body 34. The operation part 35 protrudes to the rear side from the housing 24. The position of the second lock 32 can be changed to the lock position or the unlock position by moving the operation part 35 left and right. At this time, the user can obtain a feeling of click by elastic displacement of the protrusion 37.

[0036]

As shown in Fig. 7, contact surfaces 31A, 32A of the first lock 31 and the second lock 32 are inclined surfaces. In a case where the contact surfaces 31A, 32A contact each other in the up-down direction, a force of pushing the second lock 32 in an unlock direction (leftward in Fig. 7) is generated on the contact surfaces 31A, 32A. When the force of pushing the second lock 32 in the unlock direction becomes greater than a force of displacing the protrusion 37 downward, the lock holder 36 is separated from the protrusion 37, and the lock member 33 moves to the unlock position (see Fig. 8).

[0037]

The holder 15 of the upper side arm 13A and the holder 15 of the lower side arm 13B have substantially the same configuration. Here, the configuration of the holder 15 of the upper side arm 13A will be described, and description of the configuration of the holder 15 of the lower side arm 13B will be omitted.

[0038]

As shown in Fig. 9, each of the holders 15 of the upper and lower side arms 13A, 13B includes a plate 40 and an elastic member 41.

[0039]

As shown in Fig. 10, the plate 40 has, as a whole, substantially a rectangular plate shape long in the front-rear direction. The surface of the plate 40 has a length dimension of 60 mm and a width dimension of 12 mm. As shown in Fig. 11, the plate 40 includes, in this order from the fore side, a surface plate 42, a carbon-containing heat conduction layer 43, the heating element 44, a heat conduction layer 45, a temperature sensor 46, an elastic sheet 47, an insulating sheet 48, a pressing member 49, a temperature fuse 51, and a bracket 52.

[0040]

The surface plate 42 has substantially a rectangular plate shape long in the front-rear direction. The surface plate 42 forms a contact surface which is to contact hair. The surface plate 42 is formed with a plurality of holes 53 which penetrate the surface plate 42 in the fore-back direction. The holes 53 are arranged at equal pitches in the length direction of the surface plate 42. The fore side of the surface plate 42 is covered with a low friction sheet. The surface plate 42 has a peripheral wall 54 along an outer peripheral edge. The peripheral wall 54 surrounds the outer peripheral side of the carbon-containing heat conduction layer 43, the heating element 44, the heat conduction layer 45, the elastic sheet 47, the insulating sheet 48, and the pressing member 49. The peripheral wall 54 has a plurality of protruding pieces 54A protruding to the back side. The protruding pieces 54A guide displacement of the plate 40 in the fore-back direction relative to the housing 24.

[0041]

The carbon-containing heat conduction layer 43 is made of a graphite sheet. The carbon-containing heat conduction layer 43 has a rectangular shape long in the front-rear direction, and has the same size as the back surface of the surface plate 42. The thickness dimension of the carbon-containing heat conduction layer 43 is uniform.

The carbon-containing heat conduction layer 43 has a thin sheet shape with flexibility. Since the carbon-containing heat conduction layer 43 has the flexibility, the carbon-containing heat conduction layer 43 is less likely to be broken even if the carbon-containing heat conduction layer 43 is thin. Since the carbon-containing heat conduction layer 43 is thin, a space in the housing 24 can be effectively used. Since the carbon-containing heat conduction layer 43 is made of the graphite sheet, the surface temperature of the surface plate 42 can be made uniform. As a result, unevenness of protein denaturation of hair due to a local temperature increase can be made less likely to occur.

[0042]

The carbon-containing heat conduction layer 43 contains a large amount of carbon, and has a higher thermal conductivity than metal. The carbon-containing heat conduction layer 43 is sandwiched between the surface plate 42 and the heating element 44. The carbon-containing heat conduction layer 43 having the high thermal conductivity is provided between the surface plate 42 and the heating element 44, and therefore, the heat of the heating element 44 is quickly transferred to the surface plate 42. In addition, the heat of the heating element 44 is quickly transferred in the plane direction of the carbon-containing heat conduction layer 43, and uniformly increases the temperature of the entire surface plate 42. The carbon-containing heat conduction layer 43 emits far infrared rays by heat. The far infrared rays are emitted to hair through the holes 53 of the surface plate 42.

[0043]

The heating element 44 is a planar heating element with flexibility. The heating element 44 is formed of a film heater configured such that a not-shown heater wire is arranged on an insulating film. The heater wire is arranged on the entire

surface of the film. The heating element 44 has substantially a rectangular shape elongated in the front-rear direction. The heating element 44 is thin and lightweight. Electrodes are provided at both front and rear end portions of the heating element 44. The electrodes are fixed to the back surface of the pressing member 49 (see Fig. 9).

[0044]

The heat conduction layer 45 is made of, for example, metal foil (for example, aluminum foil) with a high thermal conductivity. The heat conduction layer 45 has substantially a rectangular shape long in the front-rear direction, and expands thinly over the entire back surface of the heating element 44. The heat conduction layer 45 is bonded to the back surface of the heating element 44. The heat conduction layer 45 efficiently transfers the temperature of the heating element 44 to the temperature sensor 46. The heat conduction layer 45 and the carbon-containing heat conduction layer 43 have substantially the same size.

[0045]

The temperature sensor 46 is, for example, an NTC thermistor. The temperature sensor 46 senses the temperature of the heating element 44.

[0046]

The elastic sheet 47 presses the temperature sensor 46 toward the heat conduction layer 45 side (see Fig. 9). The elastic sheet 47 is a silicon sheet. The elastic sheet 47 brings the components forming the plate 40 into close contact with each other. The elastic sheet 47 has protrusions 55 for fixing the insulating sheet 48.

[0047]

The insulating sheet 48 is a mica sheet. The insulating sheet 48 insulates the components forming the plate 40.

[0048]

The pressing member 49 has substantially a rectangular plate shape long in the front-rear direction. The pressing member 49 is provided with an arrangement portion 56 in which the temperature fuse 51 is arranged.

[0049]

The bracket 52 has substantially a rectangular plate shape long in the front-rear direction. The bracket 52 fixes the temperature fuse 51 to between the pressing member 49 and the bracket 52. Both the front and rear ends of the bracket 52 have protruding pieces 52A to be caught by the housing 24. This prevents detachment of the plate 40.

[0050]

The bracket 52 has positioning portions 57 that position the elastic members 41. The positioning portions 57 are provided so as to protrude from the back surface of the bracket 52. The positioning portions 57 are provided at two front and rear locations on the bracket 52. The positioning portions 57 are positioned on both the front and rear sides of the temperature fuse 51 (see Fig. 9).

[0051]

As shown in Fig. 9, the elastic members 41 support the back side of the plate 40. The plate 40 is held in a state of floating from the housing 24 by the elastic members 41. The elastic members 41 are arranged at two front and rear locations. The elastic member 41 is tapered in side view. The elastic member 41 has a circular shape in plan view (see Fig. 10). The elastic member 41 has non-linear spring characteristics with which the elastic member 41 is more easily compressed when a load from the fore side to the back side is small than when the load is great. In other words, the difficulty in deformation of the elastic member 41 is constant at the initial stage of compression, and increases as a compression amount increases after the middle of

compression. The maximum axial compression amount of the elastic member 41 is, for example, 1.5 mm. Since the maximum compression amount of the elastic member 41 is great, the plate 40 can be greatly displaced in the fore-back direction.

[0052]

One end portion of the elastic member 41 in the axial direction thereof is a small diameter portion 41A, and the other end portion is a large diameter portion 41B. The diameter dimension of the small diameter portion 41A is smaller than the diameter dimension of the large diameter portion 41B. The small diameter portion 41A is arranged on the plate 40 side, and the large diameter portion 41B is arranged on the housing 24 side. The small diameter portion 41A is fitted onto the outer peripheral side of the positioning portion 57 provided on the bracket 52.

[0053]

The elastic member 41 is a conical coil spring. The conical coil spring has non-linear elasticity with which the conical coil spring is more easily compressed when the load from the fore side to the back side is small than when the load is great. The conical coil spring has such characteristics that coil portions do not interfere with each other when compressed. A relationship between a load on the conical coil spring and deflection of the conical coil spring is non-linear. Thus, as the load on the conical coil spring increases, the amount of change in the deflection of the conical coil spring decreases.

[0054]

The usability of the hair iron 10 was compared using 3 conical coil springs (referred to as a spring 1, a spring 2, and a spring 3) with different spring characteristics. The configuration of each of the springs 1, 2, 3 is as shown in Figs. 13 and 14. The table of Fig. 13 shows, for each of the springs 1, 2, 3, a material, a transverse elastic

modulus, a wire diameter, a minimum average diameter, a maximum average diameter, the number of turns, the number of end turns on the maximum diameter side, the number of end turns on the minimum diameter side, a spring constant, a pitch angle, and an effective coil free height.

[0055]

The load on each of the springs 1, 2, 3 was calculated using the following calculation formula 1. The deflection of each of the springs 1, 2, 3 was calculated using the following calculation formula 2.

Calculation Formula 1: $\pi \times d^4 \times G \times (\alpha - d'/(2 \times \pi \times R_s))/(32 \times R_s^2)$

Calculation Formula 2: $n/(R_2 - R_1) \times 16 \times P \times (R_s^4 - R_1^4)/(G \times d^4) + \pi \times \alpha \times (R_2^2 - R_s^2) - d' \times (R_2 - R_s)$

In the calculation formulae 1, 2, d: a wire diameter, G: a transverse elastic modulus, α : a pitch angle, d': a pitch in the height direction in solid coiling, R_s : a radius at the start of bonding, R_1 : a minimum average radius, R_2 : a maximum average radius, and P: a load.

[0056]

The load on each of the springs 1, 2, 3 and the deflection of each of the springs 1, 2, 3 were calculated using the following calculation formulae 1, 2. Calculation results and graphs are shown in Figs. 15 and 16. According to the graphs of Fig. 16, the load at the same deflection amount is the greatest in the spring 3 and the smallest in the spring 1.

[0057]

The usability of the hair iron 10 using each of the springs 1, 2, 3 as the elastic member 41 was evaluated by a plurality of hairstylists. Results are as follows. The usability of the hair iron 10 using the spring 3 as the elastic member 41 is better than the

usability of the hair iron 10 using the spring 1, 2 as the elastic member 41. The usability of the hair iron 10 using the spring 2 as the elastic member 41 is better than the usability of the hair iron 10 using the spring 1 as the elastic member 41. These evaluation results show that the more the user feels a response to displacement of the plate 40, the better the usability. That is, the user can easily displace the plate 40 with weak force and feel a response to displacement of the plate 40, and therefore, feels that movement of fingers is easily transferred to the plate 40 and has the favorable usability.

[0058]

Next, a use example of the hair iron 10 of the present embodiment will be described. The hair iron 10 has a palm size, and has a small length dimension and a small width dimension. Since the plate 40 of the hair iron 10 is small, the hair iron 10 is suitable for fine arrangement such as bangs and sideburns.

[0059]

Charge of the battery 25 is started when the USB cable 21 is inserted into the hair iron 10 to connect the power supply device to the hair iron 10. Completion of charge of the battery 25 is displayed on the display 14. When charge of the battery 25 is completed, the USB cable 21 is pulled out. The hair iron 10 is suitable for use wherever the user goes because the hair iron 10 can be used cordless.

[0060]

The hair iron 10 is operated not only by the battery 25 but also by power from the power supply device connected via the USB cable 21. Fig. 12 is a flowchart showing processing in a case where the power supply device is connected to the hair iron 10 via the USB cable 21. This processing is started when the power supply device is connected to the hair iron 10 via the USB cable 21 and the hair iron 10 is powered on. When the processing is started, a control circuit of the hair iron 10 determines whether

or not the output of the power supply device is higher than a predetermined value (for example, 36 W) (S10). When it is determined that the output of the power supply device is higher than the predetermined value (S10: YES), the control circuit of the hair iron 10 increases the temperature of the heating element 44 by the power from the power supply device (S11). On the other hand, when it is determined that the output of the power supply device is lower than the predetermined value (S10: NO), the control circuit of the hair iron 10 determines whether or not the battery 25 is sufficiently charged (S12). When it is determined that the charge of the battery 25 is insufficient (S12: NO), the battery 25 is charged (S13). On the other hand, when it is determined that the battery 25 is sufficiently charged (S12: YES), the control circuit of the hair iron 10 increases the temperature of the heating element 44 by the power from the battery 25 (S14). This flowchart ends when the hair iron 10 is powered off.

[0061]

The user removes the cap case 17, moves the operation part 35 of the lock member 33 to the unlock position, and brings the hair iron 10 into the open state. At this time, when the user tries to forcibly bring the hair iron 10 into the open state without moving the operation part 35 to the unlock position, the first lock 31 and the second lock 32 come into contact with each other. Accordingly, the user can notice that the hair iron 10 is in a locked state. Nevertheless, when the user tries to forcibly bring the hair iron 10 into the open state, the contact force between the first lock 31 and the second lock 32 increases, and the lock member 33 moves to the unlock position. This prevents damage of the base end portion 12 of the hair iron 10.

[0062]

The user slides the switch 28 forward after having brought the hair iron 10 into the open state. The power supply is turned on, and the hair iron 10 is operated with the

power from the battery 25 or the power supply device. When the charge of the battery 25 is insufficient, the display 14 displays that the battery charge is insufficient. The temperature of the heating element 44 increases to the set temperature quickly in a certain time (about 40 seconds) after the power supply has been turned on.

[0063]

The user sandwiches hair between the pair of arms 13A, 13B. The plate 40 is displaced so as to closely contact the hair. Since the stroke of the plate 40 is great, the surface of the plate 40 easily closely contacts the hair. Further, since the plate 40 is easily displaced with weak force, the user feels that movement of the fingers is easily transferred to the plate 40.

[0064]

The heat of the heating element 44 is efficiently transferred to the surface plate 42 by the carbon-containing heat conduction layer 43. The entire surface of the plate 40 is increased in temperature substantially uniformly, and the plate 40 uniformly applies heat to the hair. Further, far infrared rays are emitted from the carbon-containing heat conduction layer 43 to the hair. This makes it possible to quickly arrange the hair while leaving moisture in the hair. In addition, the protrusions 19 of the comb-shaped portions 18 can improve the flow of the hair.

[0065]

The heat of the heating element 44 is efficiently transferred to the surface plate 42 by the carbon-containing heat conduction layer 43, and therefore, is less likely to be accumulated in the housing 24. The heat inside the housing 24 is efficiently released to the outside by the comb-shaped portions 18. Accordingly, an increase in the temperature of the outer surface of the holder 15 can be suppressed so that the user can move the hair iron 10 with gripping the outer surface of the holder 15.

[0066]

After having used the hair iron 10, the user slides the switch 28 to the power-OFF position to turn off the power supply. Thereafter, the hair iron 10 is brought into the closed state, and the operation part 35 of the lock member 33 is moved to the lock position. Consequently, the first lock 31 and the second lock 32 face each other in the up-down direction, and the hair iron 10 is held in the locked state. Thereafter, the cap case 17 is placed.

[0067]

Even if the hair iron 10 is brought into the closed state while forgetting to move the switch 28 to the power-OFF position, the switch 28 is moved to the power-OFF position by placing the cap case 17. Thus, a probability of the hair iron 10 being kept powered on can be prevented.

[0068]

Next, the characteristics and effects of the embodiment configured as described above will be described. The hair iron 10 of the present embodiment includes the arms 13A, 13B extending from the base end portion 12. The arm 13A, 13B includes the plate 40 long in the direction of extending the arm 13A, 13B and the elastic member 41 that supports the back side of the plate 40. The elastic member 41 has the non-linear elasticity with which the elastic member 41 is more easily compressed when the load from the fore side to the back side is small than when the load is great. According to this configuration, since the plate 40 is displaced with small force, the plate 40 can be easily brought into uniform contact with hair. Thus, the plate 40 does not need to be strongly pressed against hair so that the hairstyle can be favorably arranged without damaging the hair. Further, since the plate 40 is displaced with small force, it is possible to respond to fine movement of the fingers.

[0069]

The elastic members 41 support the plate 40 at two locations in the direction of extending the plate 40. According to this configuration, since the entire plate 40 is supported in a well-balanced manner, the entire plate 40 can be easily brought into uniform contact with hair.

[0070]

The elastic member 41 is the conical coil spring. According to this configuration, since a sufficient deflection amount can be ensured in a small space, size reduction can be achieved. In addition, it is easy to design the reactive force of the elastic member 41 to an appropriate value.

[0071]

The arm 13A, 13B includes the surface plate 42, the carbon-containing heat conduction layer 43 expanding along the back surface of the surface plate 42, and the heating element 44 arranged on the back side of the carbon-containing heat conduction layer 43. According to this configuration, since the heat of the heating element 44 is transferred in the plane direction of the surface plate 42 by the carbon-containing heat conduction layer 43, it is easy to make the temperature of the surface plate 42 uniform. Further, since far infrared rays are generated by the carbon-containing heat conduction layer 43, it is possible to heat up to a deep part of hair while reducing thermal damage on the surface of the hair. Thus, the hairstyle can be favorably arranged without damaging the hair.

[0072]

The carbon-containing heat conduction layer 43 includes the graphite sheet. According to this configuration, the carbon-containing heat conduction layer 43 can be decreased in thickness, and the hair iron 10 can be decreased in size. In addition, since

the surface temperature of the surface plate 42 can be made uniform, unevenness of protein denaturation of hair due to a local temperature increase can be made less likely to occur.

[0073]

The carbon-containing heat conduction layer 43 has the flexibility. According to this configuration, since the carbon-containing heat conduction layer 43 is not cracked, the carbon-containing heat conduction layer 43 can be easily handled.

[0074]

The heating element 44 includes the film heater. According to this configuration, the heating element 44 can be decreased in thickness, and the arms 13A, 13B can be decreased in size. The heat of the film heater expands in the plane direction from the heater wire by the carbon-containing heat conduction layer 43. Thus, the temperature of the surface plate 42 can be made uniform in the plane direction while the arms 13A, 13B are decreased in size.

[0075]

The hair iron 10 has the battery housing 26 that houses the battery 25, and is operated with the power from the battery 25. According to this configuration, since the hair iron 10 can be used in a place without an outlet, the hair iron 10 can be easily used as a portable device.

[0076]

The hair iron 10 has the socket 22 for the USB cable 21, and is freely connectable to the power supply device via the USB cable 21. When the output of the power supply device is higher than the predetermined value, the hair iron 10 is operated with the power from the power supply device, and when the output of the power supply device is lower than the predetermined value, the hair iron 10 is operated with the power

from the battery 25. According to this configuration, in a case where the power supply device having the output higher than the predetermined value is connected, the hair iron 10 is operated with the power from the power supply device, so that it is possible to prolong the life of the battery 25 and use the hair iron 10 even if the battery 25 is not charged. When the power supply device having the output lower than the predetermined value is connected, the hair iron 10 is operated with the power from the battery 25, so that it is possible to prevent performance degradation due to insufficient output.

[0077]

<Other Embodiments>

The present invention is not limited to the embodiments described above with reference to the drawings, and for example, the following embodiments are also included in the technical scope of the present invention.

(1) In the above-described embodiment, the hair iron 10 is a straight iron that sandwiches hair between the pair of arms 13A, 13B. The hair iron is not limited thereto, and may be a curl iron having one cylindrical arm extending from a base end portion and a plate along the outer peripheral surface of the arm and sandwiching hair between the arm and the plate.

(2) In the above-described embodiment, the carbon-containing heat conduction layer 43 is a sheet with the flexibility. The carbon-containing heat conduction layer is not limited thereto, and may be a hard plate member or one to which a carbon material is sprayed.

(3) In the above-described embodiment, the elastic member 41 is the conical coil spring. The elastic member is not limited thereto, and may be any elastic member as long as the elastic member is more easily compressed when the load from the fore

side to the back side is small than when the load is great, such as a block-shaped member made of an elastic material or a combination of a plurality of spring members. In a case where the plurality of elastic members is combined, those having different elastic forces may be combined. The elastic member may be, for example, rubber, a leaf spring, an unequal pitch coil spring, or a tapered coil spring.

(4) In the above-described embodiment, the small diameter portion 41A of the conical coil spring is arranged on the plate 40 side, and the large diameter portion 41B is arranged on the housing 24 side. The present invention is not limited thereto, and the small diameter portion of the conical coil spring may be arranged on the housing side and the large diameter portion may be arranged on the plate side.

(5) In the above-described embodiment, the elastic members 41 support the plate 40 at two locations. The present invention is not limited thereto, and the elastic members may support the plate at three or more locations.

(6) In the above-described embodiment, the battery 25 is rechargeable. The battery is not limited thereto, and may be, for example, a dry battery.

(7) In the above-described embodiment, the dimensions of the plate 40 have been described as an example. The present invention is not limited thereto, and the dimensions of the plate can be appropriately changed.

LIST OF REFERENCE SIGNS

[0078]

10	Hair Iron
12	Base End Portion
13A, 13B	Arm
40	Plate

41 Elastic Member

CLAIMS

1. A hair iron comprising:
an arm extending from a base end portion,
wherein the arm has a plate long in a direction of extending the arm and an elastic member that supports a back side of the plate, and
the elastic member has non-linear elasticity with which the elastic member is more easily compressed when a load from a fore side to the back side of the plate is small than when the load is great.
2. The hair iron according to claim 1, wherein the elastic member supports the plate at two or more locations in the extending direction.
3. The hair iron according to claim 1 or 2, wherein the elastic member is a conical coil spring.