

March 25, 1941.

J. A. MAIZE

2,235,895

METHOD AND APPARATUS FOR PERMANENT HAIR WAVING

Filed April 2, 1938

2 Sheets-Sheet 1

Fig. 1

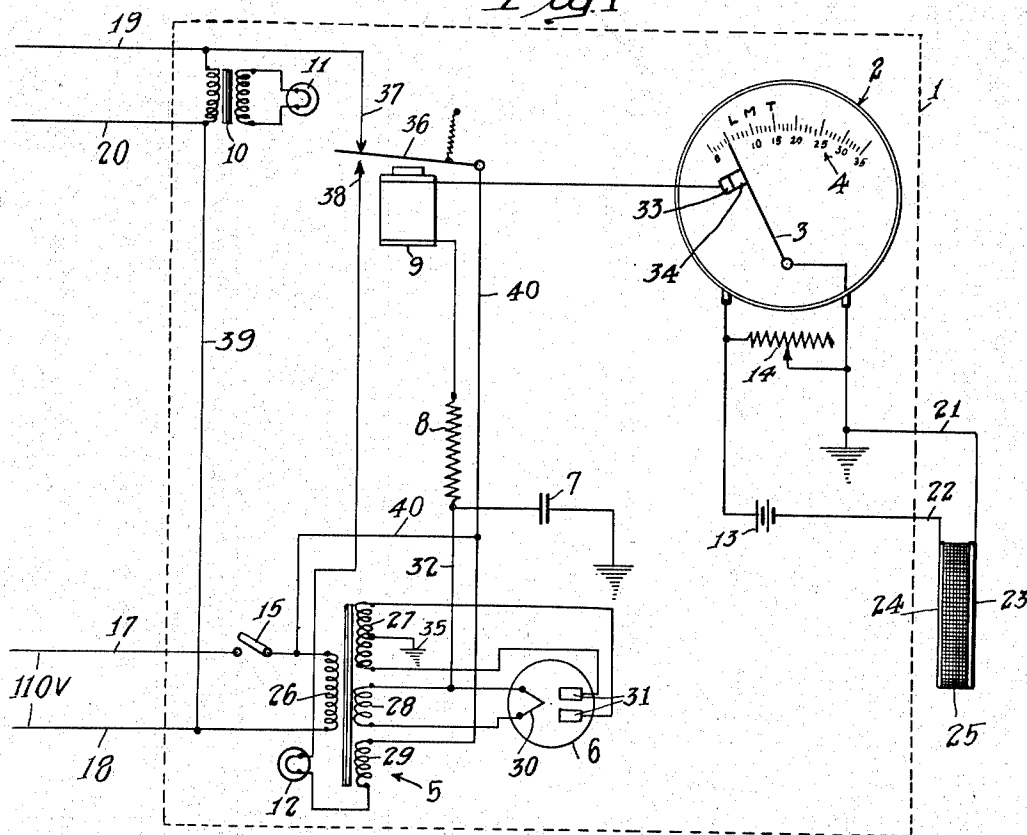


Fig. 2

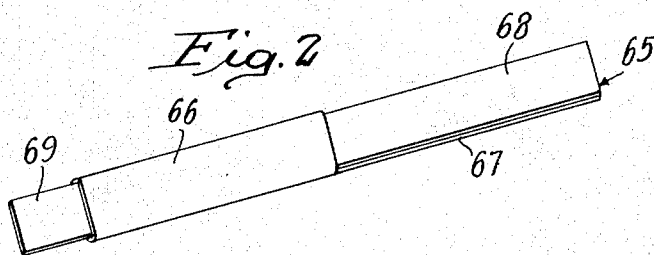
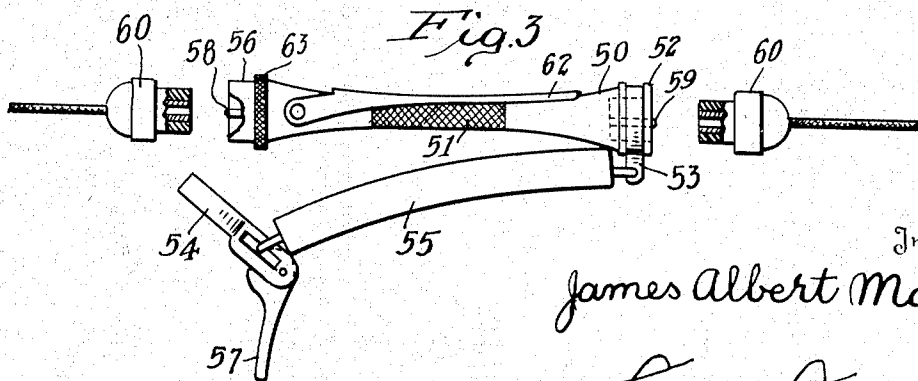


Fig. 3



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2 Sheets-Sheet 2

Fig. 4

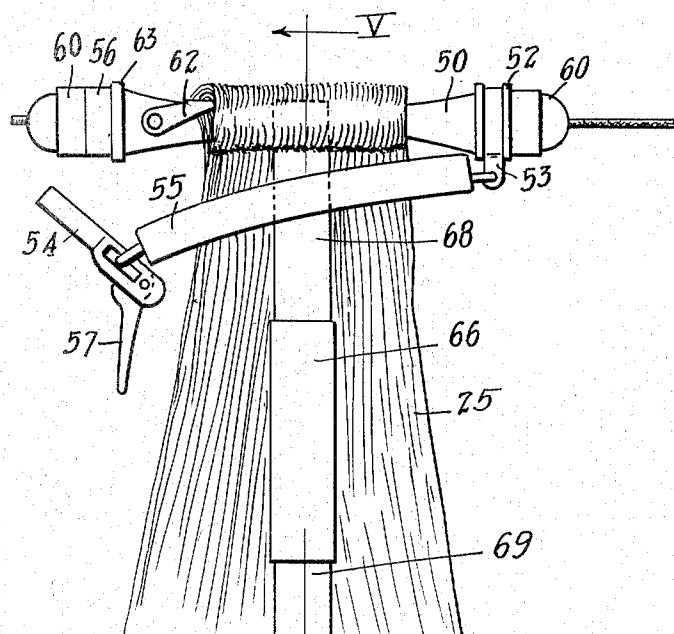


Fig. 5

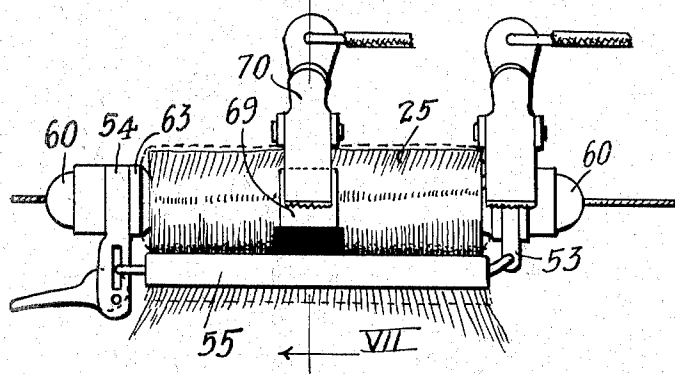
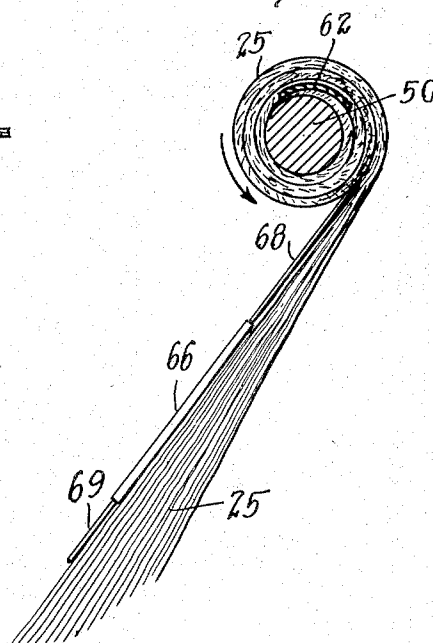


Fig. 6

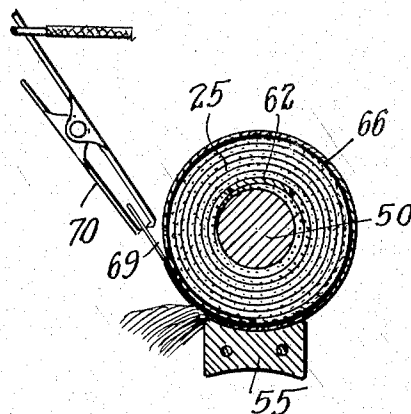


Fig. 7

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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR PERMANENT
HAIR WAVINGJames Albert Maize, Salt Lake City, Utah, assignor
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trustee

Application April 2, 1938, Serial No. 199,659

11 Claims. (Cl. 219—24)

This invention relates to the art of permanent hair waving, and has as a broad object to make it possible to accurately determine the optimum heating or steaming time without relying upon the exercise of skill by the operator.

Another object is to indicate during the actual steaming of the hair the different stages of the cycle of changes through which the hair passes during the process.

Another object is to provide a simple and reliable method and apparatus for indicating changes in the electrical resistance of hair while the hair is in the process of being waved.

Still another object is to provide a simple apparatus for indicating when a predetermined percentage change has occurred in an electric current irrespective of the absolute value of the current.

The process of permanent waving of hair as it is generally and almost universally practiced, consists in first treating the hair with a suitable solution, such as ammonia, for example, then winding or twisting the hair into the desired configuration, and while still forcibly retained in that configuration, applying heat to it for a period of time. Under the influence of the solution and the heat, the hair first becomes soft and plastic and assumes or acquires the twist or curl imparted to it. Then as the heating continues, the hair recovers its strength and elasticity and if the heat is stopped at the proper time the hair is restored substantially to its original physical condition except that it has the desired curl or wave permanently set in it.

It is important, to obtain a good permanent wave, that the heating be stopped at just the right time. If the time is too short, the wave is not as tight and permanent as it should be; if the time is too long the hair may be injured so that it becomes frizzy and splits badly, particularly after a few shampoos. Also, too long a heating period may actually be productive of a weaker wave than the optimum time because the cycle of changes recited sometimes repeats itself, under which condition the heating may be stopped while the hair is in a relatively plastic state.

Although it has previously been known that the hair went through a definite cycle of changes and that it was important to stop the heating at just the right step in the cycle, to the best of my knowledge it has not previously been known how the changes taking place in the hair could be determined and followed during the heating period. As a result, since different types and

grades of hair require different heating times, careful operators have always made several test curls, with different timing, prior to giving a permanent wave. However, it is impracticable to make very many tests, and the time, as decided by such tests, is usually only a very rough approximation of the optimum time to obtain the best results.

In accordance with the present invention, I have discovered that during the heating stage of a permanent waving operation, the changes in the physical characteristics, i. e. strength and elasticity, are accompanied by changes in the electrical resistance and that by determining and indicating the changes in resistance of the hair during the heating operation, the time when the heating should be discontinued can be easily and accurately ascertained.

More specifically, I have discovered that at the starting of the heating period, the resistance of the hair is high but that it drops as the heating continues and the hair becomes plastic, but then increases as the hair recovers its strength and elasticity, returning almost, but not quite, to its initial high value. I have further discovered that the optimum time of heating for any particular hair can be determined sufficiently definitely for practical purposes from the electrical resistance cycle of that hair, and that definitely uniform waving results can be obtained in all cases by terminating the heating period when the electrical resistance of the hair has risen to a value bearing a definite ratio to the minimum value it reached during the earlier stages of the heating period (the stage when the hair became most plastic).

For the purpose of explaining the invention, a preferred apparatus and procedure will now be described in detail with reference to the drawings, it being understood that various changes and modifications in the particular apparatus and procedure to be described can be made without departing from the invention.

In the drawings:

Fig. 1 is a diagram showing schematically an electric circuit that may be employed in practicing the invention;

Fig. 2 is a perspective view of an electrode element that may be employed;

Fig. 3 is a side view of a standard form of rod or spindle employed in permanent waving;

Fig. 4 is an elevation view showing a lock of hair partially wound upon the spindle shown in Fig. 3, with the electrode element shown in Fig. 2 being wound with the hair;

Fig. 5 is a view taken approximately in the plane V—V of Fig. 4;

Fig. 6 is a view showing a lock of hair completely wound upon the curling rod and then in place ready for application of heat; and

Fig. 7 is a sectional view taken approximately in the plane VII—VII of Fig. 6.

Referring first to Fig. 1, there is illustrated schematically the essential elements of a practicable circuit that may be employed for controlling heating periods of an electrically energized permanent wave machine. Most of the elements shown in Fig. 1 may be conveniently housed in a cabinet which is represented schematically by the dotted line 1.

The cabinet 1 contains a current indicating meter 2 having a hand or needle 3 adapted to move across a scale 4; a power transformer 5; a rectifier tube 6; a filter condenser 7; a resistor 8; a relay 9; a power transformer 10; a pair of signal lamps 11 and 12, respectively; a battery 13; a variable resistance 14; and a switch 15. The meter 2 is so mounted that its face is visible and separate knobs are preferably provided on the exterior of the cabinet for actuating the switch 15 and the variable resistor 14. Extending from the cabinet are a pair of wires 17 and 18, respectively, adapted to be connected to a suitable supply of alternating current, such as the usual 110-volt lighting circuit. There also extends from the cabinet a pair of conductors 19 and 20, respectively, for energizing the permanent wave machine proper, which is not shown in Fig. 1, and a pair of conductors 21 and 22 respectively, which extend to a pair of electrodes adapted to make contact with a portion of the hair that is being waved.

There will be described later a specific electrode structure that may be conveniently employed with existing hair waving equipment. For the present it may be assumed that the conductors 21 and 22 connect to electrodes 23 and 24, respectively, which are in contact with a mass of the hair (schematically indicated at 25 in Fig. 1), which is in the process of being waved.

When the conductors 17 and 18 are connected to a source of alternating current, and the switch 15 is closed, the primary winding 26 of transformer 25 is energized, thereby energizing the secondary windings 27, 28 and 29, respectively. Current from winding 28 heats the cathode 30 of the vacuum tube rectifier 6 and current from winding 27 flows alternately from opposite ends thereof through anodes 31 of the tube 6 to the cathode 30 thereof, thereby applying potential to a conductor 32 which connects through resistor 8 to the winding of relay 9 to a contact 33 in the meter 2, and when the needle 3 is in the position shown in Fig. 1, a contact 34 thereon lies against the contact 33, completing a circuit through the needle to ground 34 and back through a ground connection 35 to winding 27. Under the conditions described, a current will flow through the relay 9, energizing the latter, causing it to attract its armature 36 away from a back contact 37 against which it normally rests and against a front contact 38. Current supply conductor 19 is permanently connected within the cabinet 1 by a conductor 39 to the conductor 20 extending to the permanent waving machine, and when the armature 36 is closed on its back contact 37 the circuit is completed from the current supply conductor 17 through switch 15, a conductor 40, through armature 36 and back contact 37 and the other conductor 19 extending through the permanent wav-

ing machine, thereby supplying power to energize the machine. So long as power is applied to the permanent wave machine through conductors 19 and 20, the lamp 11 is energized by current supplied from conductors 19 and 20 through the transformer 10. Of course whenever relay 9 is energized to break contact between armature 36 and back contact 37, the current supplied to the permanent wave machine and to the lamp 11 is broken and the lamp 11 is extinguished. However, when the relay 9 is energized, the armature 36 closes on the front contact 38, thereby completing a circuit from one end of the secondary winding 29 through conductor 40, armature 36, front contact 38 and lamp 12 back to the other end of winding 29, thereby illuminating the lamp 12. Lamps 11 and 12 are preferably of different colors; thus lamp 11 may be green and lamp 12 may be red. When the green lamp 11 is illuminated the operator is apprised of the fact that current is being applied to the permanent wave machine. When the green lamp is extinguished and the red lamp 12 is illuminated, the operator is thereby apprised that the control device has cut off the current supply to the permanent wave machine.

It will be observed that the relay 9 can be energized to cut off the current supply to the permanent wave machine over conductors 19 and 20 only when the contacts 33 and 34 within the meter 2 are closed. Closure of contacts 33 and 34 normally occurs only when the current flowing through the instrument 2 is zero or has a relatively small value.

As previously indicated, current for energizing the meter 2 is supplied from the battery 13 through the electrodes 23 and 24, which are in electrical contact with a mass of hair 25 which is being waved. Therefore all current applied from the battery 13 to the meter 2 must flow through the mass of hair 25 and the value of the current flowing at any instant will be determined to a large extent by the resistance of the hair 25, since the resistance of the winding of the meter 2 is relatively low in comparison with the resistance of the hair.

For the reason that the hair of different individuals differs substantially in resistance characteristics and that it is impracticable to attempt to always position the same volume of hair at the same pressure and in the same configuration between the electrodes 23 and 24, the absolute value of the resistance of the hair 25 in successive different operations will vary quite widely. However, in accordance with the present invention, I can compensate for such variations by varying the sensitivity of the meter 2. Such variations in sensitivity are effected by varying the variable or adjustable resistance 14 connected in shunt to the meter 2, so that only a portion of the total current passing through the hair is applied to the meter winding, and this portion may be varied according to the absolute resistance of the particular mass of hair being tested. Such variations in the sensitivity of the meter 2 are permissible because I depend upon relative changes in the resistance of the hair and not upon the absolute value of the resistance.

A full explanation of the operation will now be given by describing the actual mode of procedure that may be employed.

Assume that the head of hair to be given a permanent wave has been treated with the permanent waving solution; the hair wound upon the curling rods of the waving machine, which it is assumed will be electrically energized, and the

machine connected to the conductors 19 and 20 (switch 15 being open at this time). Assume further that a portion of the hair on one of the curling rods of the machine is positioned between the electrodes 23 and 24, and that the variable resistance 14 is adjusted to its maximum value so that it does not materially reduce the sensitivity of the meter 2.

The meter 2 is chosen of such sensitivity relative to the potential of the battery 13 and the normal further resistance of the mass of hair positioned between the electrodes 23 and 24 that under the conditions described, the needle 3 will move a short distance, carrying the contact 34 away from the contact 33. The exact distance the needle moves is not particularly pertinent.

Having completed the operations described and having observed that the needle 3 has moved to carry the contact 34 clear of the contact 33, the operator closes the switch 15, thereby completing the circuit previously traced from supply conductors 17 and 18 over the armature and back contact of the relay 9 to the conductors 19 and 20 extending to the permanent wave machine. The latter is therefore energized and heat is applied to the curling elements on which the hair is wound.

For purposes of the present invention, it is immaterial how the heat is generated within the curling elements. They may contain electrical heating elements, each electrically connected to the machine, or each might be supplied with steam from a boiler in the machine, the supply of steam being controlled by the current supplied from conductors 19 and 20.

As the heat is applied to the hair and the waving process proceeds, the resistance of the mass of hair between the electrodes 23 and 24 decreases quite markedly, thereby causing the current through the meter 2 to be increased, and causing the needle 3 to rise further up on the scale. The operator observes the rise of the needle 3, particularly with reference to the maximum reading of the instrument. In this connection it may be stated that the resistance of the hair during the waving process first decreases to a minimum value and then increases. When the resistance of the hair has reached its minimum value, the needle 3 will have moved a substantial distance over the scale 4 and thereafter will begin to retrace its movement. As soon as the operator notices that the needle has begun to move back toward the zero position, she adjusts the variable resistance 14 to reduce the sensitivity of the instrument sufficiently to bring the needle back to one of the three marks L, M or T on the scale of the instrument. It is understood of course that the instrument 2 is chosen of such sensitivity that with the highest resistance hair obtainable in practice the maximum reading of the instrument in its most sensitive adjustment will exceed the point T on the scale.

Having re-set the needle to one of the points L, M or T, the operator pays no more attention to the machine, since from that point on it is fully automatic in operation. Thus as the resistance of the hair being waved rises, the current through the instrument 2 drops until the contact 34 on needle 3 closes on contact 33, thereby completing the circuit previously described to energize the relay 9, causing the latter to move armature 36 of its back contact 37 and thereby interrupt the supply of current from conductors 19 and 20 to the permanent wave machine, deenergizing the latter and stopping

the heating of the hair-curling elements. The operator is apprised of the completion of the operation by the extinguishing of the green lamp 11 and the illuminating of the red lamp 12. She thereupon opens switch 15, which deenergizes the apparatus within the cabinet.

Whichever one of the three indexes L, M or T the needle 3 is re-set to, when the current has reached or passed its maximum value, is determined by the type of wave desired. Thus the index L signifies a loose wave, since it will require a relatively short time for the needle to drop from this index to the point of closure of contact 33 and 34. The index M signifies a medium wave and if the needle is set to this point it will require a longer time for the needle to drop back to the position of contact closure and hence the heating time will be longer. The index T signifies a tight wave and if the needle is re-set to index T, then the time required for the needle to drop back to the point of contact closure will be greatest and accordingly the heating time will be longest. It is understood, of course, that the selection of the three indexes L, M and T is purely arbitrary and that a lesser or a larger number of indexes spaced closer or farther apart might be employed.

Let it be assumed, for purposes of example, that as shown in Fig. 1 the position of the needle 3 at the point of closure of contacts 33 and 34 corresponds to a scale deflection of 5 on the scale 4 of the instrument and that the index T is located opposite the scale indicator 15. (It is immaterial in the present discussion in what units the scale is calibrated provided the instrument is fairly accurate so that each scale division indicates the current flowing through the instrument when the needle is opposite that scale division.) Now if the shunt 14 is removed from the instrument or its circuit opened, it is obvious that the needle in moving from the scale division 15 to the scale division 5 will represent a decrease in value of 66⅔% in the current, since the current required to produce a deflection of 5 is one-third of that required to produce a deflection of 15. This relation is not changed when the shunt 14 is employed to reduce the sensitivity of the meter provided the resistance 14 does not change its value during the operation. This means, of course, that the resistance 14 must be of material having a low temperature coefficient or of sufficient size that the current passing therethrough does not heat it appreciably. This result is readily obtainable in practice. Stated in other words, at any given setting of the resistance 14, the total current delivered by the battery 13 will always divide between the resistance 14 and the instrument winding in the same proportion. Thus if the resistance 14 is so adjusted as to be equal to the resistance of the instrument 2, then the current will divide equally between the shunt resistance and the instrument, irrespective of variations in magnitude in the current and movement of the needle from the scale division 15 to the scale division 5 will always represent a decrease in value of the current of 66⅔% irrespective of the total value of current flowing. This means that if, when the current has reached its maximum value the resistance 14 is varied to bring the needle 3 to the scale division 15, then, when the current flowing through the hair subsequently drops to one-third, or 33⅓% of its maximum value, the needle 3 will have dropped to the point 5 on the scale, thereby closing the contacts 33 and 34.

It will be observed, therefore, that with the arrangement described, a drop of 66% from the maximum value of the current flowing through the hair is accurately measured and indicated, irrespective of the absolute value of the current at the time of maximum flow.

I have found in practice that if the point T is located at a scale setting three times the scale setting corresponding to closure of contacts 33 and 34, thereby interrupting the heating circuit when the conductivity of the hair has dropped to one-third of its maximum value, that a good, tight curl or wave will always be obtained.

In order to obtain what is termed in the art a medium curl, I find it necessary to interrupt the heating when the conductivity of the hair has dropped to substantially half of its maximum value. Therefore the index M is positioned at the scale division 10 when the point of contact closure is at the scale division 5.

In order to obtain what is termed in the art a loose curl, I find it necessary to interrupt heating of the hair when the conductivity of the hair has dropped only slightly, to about five-sevenths of its maximum value. Therefore the index L of the meter 2 is positioned opposite the scale reading 7.

As previously pointed out, the actual structure for applying heat to the hair while it is being curled is not shown at all in the schematic diagram of Fig. 1, and the elements for effecting electrical contact with the hair are shown schematically as plates 23 and 24. An actual waving rod that may be employed in connection with my invention, will now be described with particular reference to Figs. 2, 3, 4, 5, 6 and 7.

Referring first to Fig. 3, there is illustrated a well-known form of curling rod or spindle employed for permanent waving. It comprises a tapered spindle 50 having a roughened surface 51 for increasing friction with the hair to facilitate winding of hair thereon and having large end portions 52 for the reception of bands 53 and 54 which support a clamp 55 for securing the wound hair against unwinding during the heating operation. The collar 53 may be mounted between a pair of flanges on the end of the spindle, as shown, so that it remains in position at all times. The collar 54 on the other hand is free to slip over the end 56 of the spindle and to facilitate compressing the clamp 55 against the hair, a tensioning lever 57 is usually provided. The clamp 55 may be constructed of rubber or other yieldable material. The spindle or rod 50 is preferably of hollow metal construction and encloses an electrical heating element, the two ends of which are connected to prongs 58 and 59, which project into recesses in the two opposite ends of the spindle. Electrical connections from a common source of supply to the heating element is had by means of socket members 60 which are pressed into the recesses in opposite ends of the spindle and make electrical connections with prongs 58 and 59, respectively. The sockets are connected by suitable insulated wires to the source of supply which may be constituted by extensions of the conductors 19 and 20 in Fig. 1. A small metal clamp 62 is hingedly mounted on the spindle to aid in locking the ends of a lock of hair to be wound upon the spindle.

In practice, the collar 54 is released from the end of the spindle and the connecting sockets 60 removed from the spindle. The clamp 62 is then swung away from the spindle and the ends of a lock of hair placed against the spindle and

secured in place by pressing the clamp 62 down thereover. The lock of hair is then wound onto the spindle by rotation of the spindle, such rotation being facilitated by a knurled end portion 63 which can be twirled between the fingers.

In accordance with prior practice, the hair is wound in as nearly uniform layers as possible on the spindle until the latter is close against the scalp and then the clamp 55 is locked into position with the clamp against the scalp to support the spindle and the hair thereon a slight distance away from the scalp so that the scalp will not be burned when the spindle is heated. The sockets 60 are then plugged into the rod and the heating current applied.

The mode of winding the hair onto the spindle is exactly the same when employing my invention, except that an auxiliary electrode for measuring the resistance of the hair is wound up with the hair on the spindle. Obviously, an electrode, in order to be wound up with the hair on the spindle, must be flexible. Such an electrode is disclosed in Fig. 2 and comprises an elongated strip 65 of thin metal foil to which there is secured a coating 66 of insulating material which may be Cellophane. A Cellophane strip may also be extended along one side only of the foil strip 65 beyond the area of complete enclosure by the Cellophane. Thus such a backing strip is indicated at 67 in Fig. 2. It is not essential, however. The strip 65 has an exposed conductive surface 68 of fixed area. The Cellophane enclosure 66 is convenient in handling the strip. One end 69 of the foil projects a short distance beyond the Cellophane covering 66 to facilitate the making of electrical connection to the foil. The electrode structure disclosed in Fig. 2 is introduced between successive layers of hair on the spindle when the spindle is spaced a few inches away from the scalp, as clearly shown in Figs. 4 and 5, the foil being wound up on the spindle between the successive layers of the hair with the surface 68 of the foil toward the spindle. The length of the exposed portion of the foil face 68 is such as to extend substantially one turn about the spindle with an average amount of hair thereon. When the hair is all wound on the spindle, as shown in Figs. 6 and 7, a small portion of the Cellophane 66 and the exposed end 69 of the foil project away from the coiled hair and electrical connection is made to the foil by snapping a spring clip 70 over it, as shown in Figs. 6 and 7. The foil strip constitutes one of the electrodes 23 or 24 in the schematic diagram of Fig. 1, and the other electrode is constituted by the metal spindle itself on which the hair is wound. Hence connection to the other electrode is effected by snapping a clip leading from one of the conductors 21 and 22 over any exposed metal part of the spindle. It is to be understood that the electrical heating element within the spindle is electrically insulated from the spindle so that there is no circuit connection directly between the heating element and the spindle body.

It is the usual practice to also wind up with the hair during substantially the last revolution of the spindle, a sheet of Cellophane or other sheet material relatively impervious to moisture, to act as an insulating medium to enclose the hair and insure uniform heating and steaming thereof, when the spindle is electrically heated.

It will be obvious from an inspection of Figs. 4, 5, 6 and 7 that it is impossible, in practice, to always position the same amount of hair at the

same pressure between the two electrodes corresponding to electrodes 23 and 24 in Fig. 1 (one of these electrodes being the spindle and the other the foil strip 65, in practice). Therefore, even if all hair had the same resistance characteristics it would be impossible to always obtain the same absolute values of current flow between the two electrodes. Such unavoidable variations in the absolute magnitude of the current are not important, however, in view of the use of the shunt resistance element 14 on the instrument 2 which functions as an adaptor to adapt the instrument to function in a definite predetermined manner in response to percentage changes in the current through the hair, irrespective of the absolute magnitude of the current.

Of course in practice a large number of the curling spindles or rods described are employed in order to wave all the hair on a head. It is not necessary, however, to test the resistance of the hair upon all of the rods. With a normal head of hair, it is sufficient to incorporate the electrode structure described in only one of the rods and control the application of heat to all of the rods in response to the changes in resistance of the hair on the one rod. In some instances, as the result of scalp injuries, the hair on different portions of a single scalp has such different physical characteristics that different heating times are required. In such cases, of course, the hair on each different portion of the scalp is waved separately from the rest and the time of each operation controlled by changes in the resistance of a portion of the hair being waved.

As previously indicated, the resistance characteristics of hair having different physical characteristics, is different, and by controlling the heat in accordance with the changes in resistance of the particular hair being waved, successful results are automatically obtained without the exercise of skill on the part of the operator.

Although the invention has been explained by describing in some detail a particular apparatus that may be employed, it is to be understood that radical changes can be made from the particular apparatus disclosed while still employing the invention, and the latter is to be limited only as set forth in the appended claims.

I claim:

1. The method of determining the progress of a permanent hair waving operation, which comprises ascertaining and indicating variations in the electrical resistance of a portion at least of the hair during the operation.

2. The method of gauging the length of the heating period in the permanent waving of hair, which comprises continuously ascertaining changes in electrical conductivity of a portion

of said hair during the heating period, and terminating the heat when the conductivity falls to a predetermined fraction of its maximum value.

3. In combination, means for supporting and heating treated hair to impart a permanent wave thereto, and means for simultaneously ascertaining and indicating variations in the electrical conductivity of a portion at least of said hair being heated, whereby changes produced in the hair by the heating operation may be ascertained.

4. In combination, means for supporting and heating treated hair to impart a permanent wave thereto, means for simultaneously ascertaining variations in the electrical conductivity of a portion at least of said hair being heated, and means responsive to a predetermined change in said conductivity for controlling said heating means.

5. In combination, means for supporting and heating treated hair to impart a permanent wave thereto, means for simultaneously ascertaining variations in the electrical conductivity of a portion at least of said hair being treated, said last-mentioned means comprising electrode means for contacting a mass of hair while the latter is being waved, a source of current and a current-responsive device connected with said electrode means.

6. Apparatus as described in claim 5, with means for varying the degree of response of said current-responsive device to current flowing through said hair.

7. Apparatus as described in claim 5, with means for varying the sensitivity of said current-responsive device.

8. Apparatus as described in claim 5, and an adjustable current conducting element connected in shunt with said current-responsive device for varying its degree of response.

9. Apparatus as described in claim 5, in which said hair supporting and heating means includes a spindle on which hair is wound, said spindle constituting a part of said electrode means, and a flexible conductive sheet element adapted to be wound with hair upon such spindle and constituting another element of said electrode means.

10. In a permanent waving apparatus, means for heating hair, means cooperating with said heating means for testing the electrical conductivity of the hair while being heated, and means responsive to said testing means for controlling said heating means.

11. In a permanent waving apparatus, hair-heating means, and means for controlling said heating means in response to variations of electrical conductivity of hair heated by said heating means.

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