United States Patent

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[15] **3,642,010**

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[54] ULTRASONIC METHOD FOR HAIR JOINING

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[73] Assignee: **Ultrasonic Systems, Inc.**, Farmingdale, N.Y.

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[52] **U.S. Cl.** **132/5**

[51] **Int. Cl.** **A41g 5/00**

[58] **Field of Search** 132/5, 53; 156/73

[56] **References Cited**

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Assistant Examiner—J. N. Eskovitz
Attorney—Leonard W. Suroff

[57] **ABSTRACT**

The method for joining hair together utilizing ultrasonic vibrational energy in which the overlapping portions of the commercial hair and the live hair are maintained in fixed position to each other when the energy is introduced therein. The hair may be coated internally or externally with a thermoplastic material which acts as the bonding agent.

23 Claims, 14 Drawing Figures

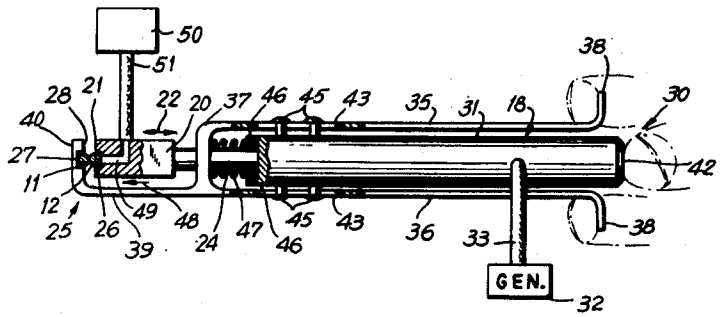

FIG. 1

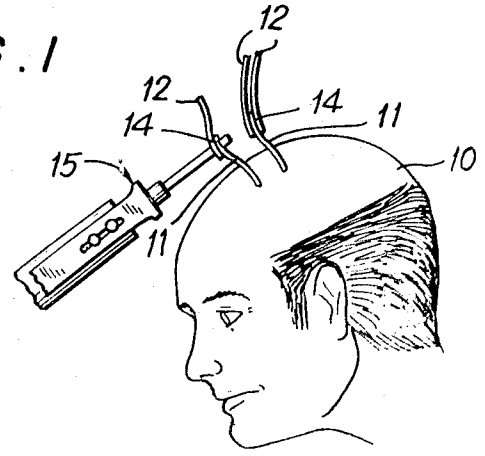

FIG. 2

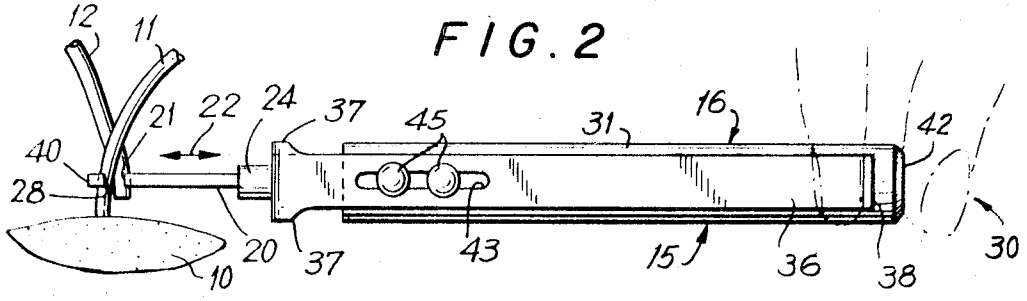

FIG. 3

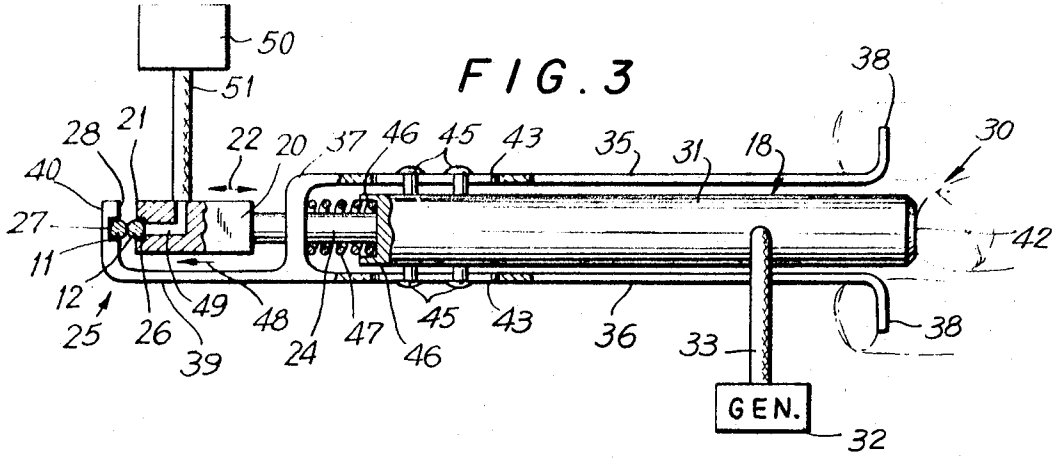

FIG. 4

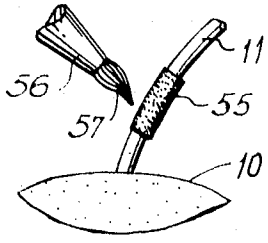

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FIG. 5

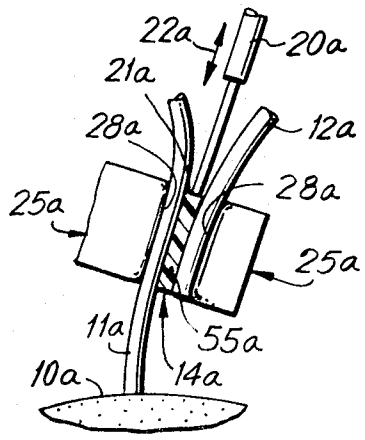

FIG. 6

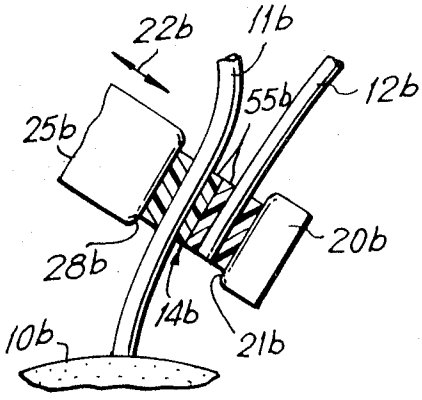

FIG. 7

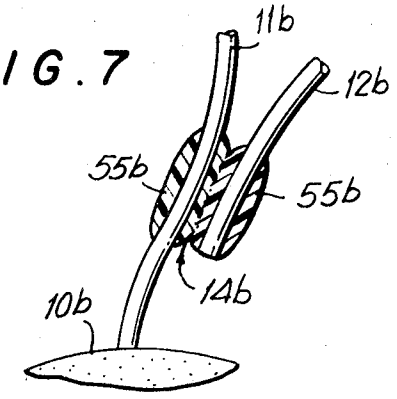

FIG. 8

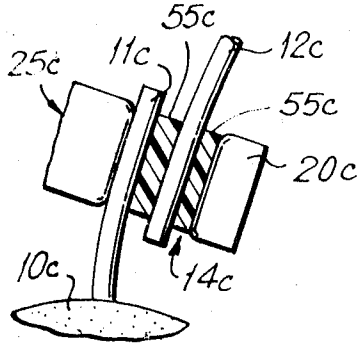

FIG. 9

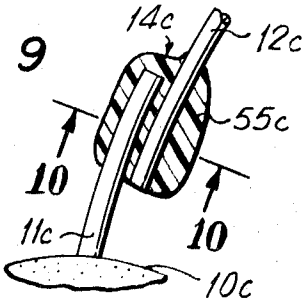

FIG. 10

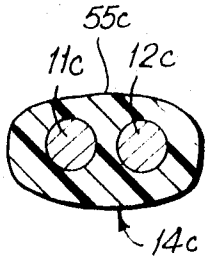

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FIG. 11

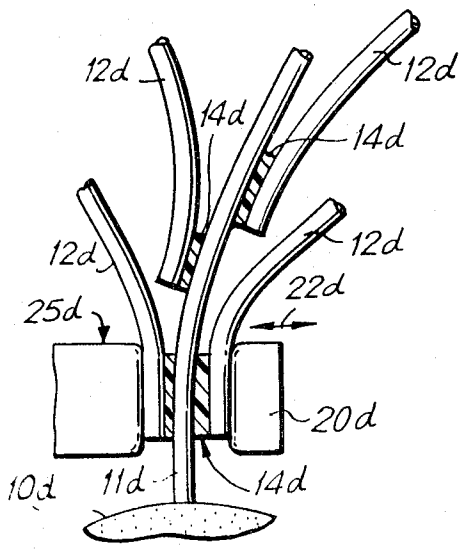


FIG. 12

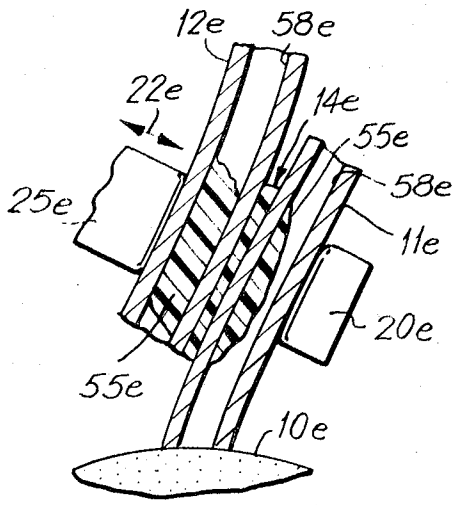
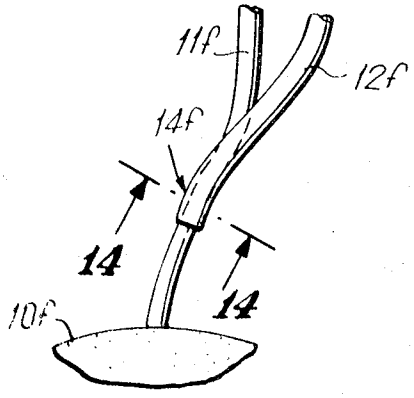


FIG. 13



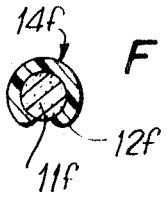


FIG. 14

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ULTRASONIC METHOD FOR HAIR JOINING

BACKGROUND OF THE INVENTION

The invention relates generally to improvements in permanently attaching commercial hair to live hair and more particularly to improved methods and apparatus for joining the hair together with ultrasonic mechanical vibrational energy. Ultrasonics is defined as a general term referring to the generation and utilization of vibratory mechanical energy, usually but not necessarily beyond the audible range.

Before proceeding to the details of the present invention, let us first briefly review generally known facts about "hair weaving" as is generally referred to today. Two approaches to the problem are illustrated in U.S. Pat. Nos. 2,621,663 and 3,295,534. Another procedure used today requires the actual tying of the hair together by forming knots, with an eventual retreatment required when the live hair grows out and the knot becomes visible. This procedure of tying knots is extremely difficult and time consuming. Knots in general also have a tendency to slip.

OBJECTS OF THE INVENTION

It is the general object of the present invention to avoid and overcome the foregoing and other difficulties of, and objections to prior art practices by the provision of improved methods and apparatus for joining hair with ultrasonic energy.

Another object of the present invention is to provide a method by which commercial human hair can be joined or attached to live hair on the human head using ultrasonic energy.

Another object of the present invention is the reduction of time required to join hair as compared to prior practices.

Another object of the present invention is to provide an ultrasonic method of hair joining which may easily be performed by a person without any assistance.

Another object of the present invention is to provide an ultrasonic method of suturing which is less time consuming than procedures practiced to date.

Another object of the present invention is to provide an ultrasonic method and apparatus which eliminates the tying of knots in hair-thickening practices.

Other objects of the present invention will become obvious and apparent as the disclosure proceeds.

SUMMARY OF THE INVENTION

In accordance with the invention the method of joining hair together with ultrasonic energy comprises bringing respective segments or portions thereof in overlapping relationship to each other to form a junction portion. Ultrasonic vibrational mechanical energy is then introduced into the area of overlap in a proper direction and for a period of time to obtain a bond between the overlapping segments of hair.

The ultrasonic bonding is accomplished by using members or welding tips having a small area of contact, with at least one of the welding tips being resiliently supported so that the welding tips can be moved relatively toward each other, in a way similar to the prongs of a pair of tweezers, for suitably gripping the hairs. Positioning means are preferably provided on one of the welding elements for accurately locating and retaining segments of the hair in overlapping relationship to each other and with respect to the welding tips.

The ultrasonic energy is introduced in a proper direction through at least one of the welding tips, which take the form of supporting and vibratory means, at a suitable frequency and amplitude to cause a joining or welding together of the held hair segments.

In accordance with another aspect of the invention one or both of the hairs to be joined may be coated or impregnated externally, internally, or both, with a bonding agent capable of fusing and joining the hairs together upon the introduction of the ultrasonic energy. The bonding agent may be of a thermoplastic material such as nylon, that may be manually or automatically applied to the hairs in the zone they are to be joined, and is in a substantially solid state when the ultrasonic energy is applied thereto. The energy causes a flow thereof until the hairs are fused together with the bonding agent becoming hard upon the stopping of the ultrasonic energy.

BRIEF DESCRIPTION OF THE DRAWINGS

Although the characteristic features of this invention will be particularly pointed out in the claims, the invention itself, and the manner in which it may be made and used, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part hereof, wherein like reference numerals refer to like parts throughout the several views and in which:

FIG. 1, is a view in side elevation of a person's head showing the manner in which hair is secured to existing hairs with ultrasonic energy;

FIG. 2, is a top longitudinal view of one form of ultrasonic system, of the type capable of being hand held and manipulated, for joining hairs in accordance with the invention;

FIG. 3, is a side longitudinal view, partly in cross section of the ultrasonic system of FIG. 2;

FIG. 4, is a somewhat diagrammatic view illustrating the application of a bonding agent to the human hair;

FIGS. 5–10 inclusive, are somewhat diagrammatic views on an enlarged scale showing the manner in which additional strands of natural or artificial hairs are secured to existing hairs;

FIG. 11, is a somewhat diagrammatic view on an enlarged scale showing the manner in which additional artificial or supplementary hair strands are joined to an individual hair;

FIG. 12, is a somewhat diagrammatic view on an enlarged scale showing the manner in which the bonding agent is contained within the core of the hair; and

FIGS. 13 and 14, diagrammatically illustrate the joining of a supplemental hair of a plastic material to a human hair.

PREFERRED EMBODIMENTS OF THE INVENTION

Referring to the drawing, and particularly to FIGS. 1–3 thereof, 10 indicates the scalp of a person's head on which it is assumed there is growing a certain amount of live hair 11. In accordance with the practice of the present invention it is desired to increase the number of hairs on the scalp 10, by the attachment of artificial or natural hair 12, to the existing live hairs 11 with an ultrasonic welding instrument 15. The added hair may be of a synthetic plastic material.

FIGS. 2 and 3 illustrate one form 15 of the ultrasonic system for joining together overlapping segments of the hairs 11 and 12 to form a junction portion or zone 14. The system includes vibrator means 16 in the form of a hand-held instrument, including an ultrasonic transducer or motor 18 for effecting the high-frequency vibrations of the tool member 20 terminating in a working surface 21 that extends in a plane substantially normal to the direction of mechanical vibrations illustrated by the arrow 22. The base 23 of the tool member 20 is secured to an insert portion 24. Supporting means 25 is provided to act as an anvil or clamp, so that the overlapped layers of hair 11 and 12 may be compressed between the positioning means in the form of a groove or slot 26 on the tool 20 and slot 27 provided on said support means.

The ultrasonic motor 18, as illustrated, may be in the form of a driving member adapted for being hand held as by an operator 30, and generally comprising a tubular housing or casing 31 into which the insert unit 24 supporting the tool member 20 may be partially telescoped. The ultrasonic motor 18 is energized by an oscillation generator 32 with a power cable 33, connecting the two together. The generator is an oscillator adapted to produce electrical energy having an ultrasonic frequency which may be in the range of 5,000 to 100,000 cycles per second, but preferably in the range of 20,000 to 60,000 cycles per second.

The ultrasonic motor 18 may be one of a variety of electromechanical types, such as electrodynamic, piezoelectric and magnetostrictive. The ultrasonic motor 18 for effecting

welding procedures through hand-directed tools of suitable configuration, which are readily replaceable or interchangeable with other work-performing tools in acoustically vibrated material treating devices, may be of the type well known in the art, and wherein each work tool member is rigidly joined in end-to-end relationship to a connecting body or acoustic impedance transformer and to a transducer which may form an insert unit or assembly, which is removably supported in a housing, containing a coil in surrounding relationship to the transducer and receiving alternating current for producing an alternating electromagnetic field.

The transducer in the ultrasonic motor **18** is longitudinally dimensioned so as to have lengths which are whole multiples of half-wavelengths of the compressional waves established therein at the frequency of the biassed alternating current supplied so that longitudinal loops of motion as indicated by arrow **22**, occur both at the end of the insert unit **24** to which the tool member **20** is rigidly connected and the working surface **26**. Thus, the optimum amplitude of longitudinal vibration and hyperaccelerations of tool member **20** is achieved, and such amplitude is determined by the relationship of the masses of the tool member **20** and insert unit **24** which may be made effective to either magnify or reduce the amplitude of the vibrations received from the transducer. The tool member **20** may be permanently attached to the end of insert unit **24**, for example, by brazing, soldering or the like, or the tool may be provided with a threaded stud (not shown) adapted to be screwed into a tapped hole in the end of insert unit **24** for effecting the rigid connection of the tool to the stem.

The support means **25** and the vibratory means **16** may be separate instruments and utilized by one or more persons simultaneously, but yet individually. For convenience they may be combined in one hand-held instrument, for example, as disclosed herein.

If preferred the hand-held instrument disclosed in FIGS. **2** and **3** may be employed and in which the support means **25** is part of the instrument and includes a pair of legs **35** and **36** respectively, secured together at their lower end by bands **37** and provided with finger gripping means in the form of individual lugs **38** that extend outwardly from the upper end of the legs for engagement by the fingers of the surgeon or operator **30** in a manner hereinafter described. The leg **36** has a leg extension **39** that terminates in a lower extension which is a support member or arm **40** substantially at right angle to the leg extension **39**, and is provided with the support surface in the groove **27** in spaced relation to the bottom of the groove **26** of the tool member **20**. The positioning means in the form of the grooves **27** and **26** may take various forms and shapes to retain the hairs **11** and **12** in relatively fixed relation to each other during welding.

The legs **35** and **36** are in spaced relation to each other and may be contoured to conform to the cylindrical configuration of the ultrasonic transducer housing **31**. The generator **32** is connected to the transducer **18** by means of the cable **33** in a conventional manner. As seen in FIG. **3** the cable **33** may enter the ultrasonic motor **18** from the side so as to leave the rear end **42** free for engagement by the thumb or any other finger of the operator **30** to permit manual control of the relative displacement between the overlapping working and support surfaces.

The support means **25** is mounted for relative movement, with respect to the ultrasonic motor by providing a pair of slots **43** on each of the legs **35** and **36**, and which slots accept headed fasteners **45** which extend from the casing **31** through the slots **43** to permit free relative movement between the ultrasonic motor **18** and support means **25**. The lower end of the casing **31** is provided with an annular shoulder **46** which is adapted to receive spring means in the form of a spring **47**, which is contained within the shoulder **46** at one end thereof and in engagement with the bands **37** at the opposite end thereof. The spring **47** applies a force in the direction of arrow **48**, so that the working surfaces of the support means and ultrasonic motor means are biased away from each other, whereby the force applied by the operator is required to separate the overlapping working and support surfaces. The spring is coupled to the support and ultrasonic motor means so as to force them together with a predetermined static force which might be varied in a conventional manner not shown. In this manner once the static force is determined for the particular thickness of the hairs the resultant bonding may be obtained.

Accordingly the spring means may yieldably urge the support means **25** and transducer means **18** relative to each other to a position wherein the working and support surfaces **21** and **28** respectively, are normally in engagement with each other under a predetermined static force, so that the support and transducer means are first separated for the placement of the overlapping portions of hairs **11** and **12** therebetween. In contrast to this the spring means may be adjusted such that the working and support surfaces are normally maintained in spatially fixed relation to each other, so that the hair segments to be joined are positioned between the surfaces which are brought together by the operation of the hand-held instrument.

In accordance with the invention the joining of the hairs **11** and **12** may be of a permanent or semipermanent nature, and this is accomplished by properly selecting the frequency, amplitude of ultrasonic mechanical vibrations, and area of bond, to produce an optimum bonding of the hairs in their overlapping portions. The amplitude of vibration may be in the range of 0.0001 to 0.10 inches.

For certain joining applications a bonding agent is used that may be applied to the existing hair or added hair. For example, the added hairs may first be coated with a bonding agent at the end to be joined. The bonding agent may be in a substantially solid state until the ultrasonic energy is applied thereto, and then it becomes sufficently softened that under the influence of the static force applied the live hair is bonded thereto. When the ultrasonic energy is interrupted or terminated then the bonding agent becomes almost immediately hardened and set. The tool member **20** and supporting means **25** may act as a heat sink so that the thermoplastic bonding agent is quickly chilled and set by the relatively cool surface of the adjoining solid structures. The bonding agent may be automatically applied at the joining zone **14** simultaneously with the welding energy being applied. As illustrated in FIG. **3**, the tool member **20** may have a channel **49** terminating at one end at the slot **26** and at its other end on a sidewall of the tool member **20** which in turn is connected by conduit **51** to supply means **50** containing a supply of a bonding agent. When the tool member **20** is vibrated the bonding agent contained in the channel **49** becomes sufficiently fluid to flow therethrough and onto the hairs **11** and **12**. When the energy is interrupted the bonding agent becomes hardened and set to form the bond.

FIG. **4**, illustrates the scalp **10** in which the live hair **11** extends therefrom with the bonding agent **55** applied by applicator means **56**, which may be in the form of a brush **57** as illustrated. Obviously, the bonding agent may be applied to the supplemental or the live hair and may be of a thickness from 0.001 to 0.060 inch.

FIG. **5**, illustrates the invention in which the live hair **11***a* extending from the scalp **10***a* is joined to the artificial hair **12***a* with the bonding agent **55***a* extending therebetween. The bonding agent **55***a* may be applied simultaneously with the welding thereof or prior thereto on the surface of one of the hairs so that it is substantially confined to the junction portion or welding zone **14***a*. The bond is formed by positioning the overlapping segments of the hairs **11***a* and **12***a* between spaced-apart support surfaces **28***a* of supporting means **25***a*. In accordance with one form of the invention the working surface **21***a* of a tool member **20***a* which is ultrasonically vibrated in the direction of arrow **22***a* is brought into direct contact with the bonding agent **55***a*. The bonding agent **55***a* is generally selected to have the property of softening under the influence of ultrasonic mechanical vibrations and quickly hardening into a solid state when the vibrations are ter-

minated. The ultrasonic energy is applied simultaneously with a compressive force to soften the bonding agent **55***a* whereby a fusion of the hairs **11***a*, **12***a* and bonding agent **55***a* occurs, when the energy is stopped a junction is formed capable of withstanding the stresses applied thereto when the hair is combed, etc. Accordingly the mechanical vibrations may be applied directly to the bonding agent or through the hairs.

FIGS. **6** and **7** illustrate the invention in which the bonding agent **55***b* may be first applied circumferentially to both the hair **11***b* extending from the scalp **10***b* and the hair **12***b*. The hairs **11***b* and **12***b* are brought together to form a junction portion **14***b* in which the bonding agent **55***b* extends between the hairs to be joined. The portions of the hairs containing the bonding agent **55***b* is positioned between the respective surfaces **21***b* and **28***b* of the tool member **20***b* and supporting means **25***b*. Upon the application of the ultrasonic energy in a plane substantially normal to the axis of the hairs the mechanical energy due to acoustic softening causes a flow of the bonding agent until the formation of the junction as seen in FIG. **7**. The length of the surface **21***b* and **28***b* may be greater than that of the bonding agent **55***b*. In addition the surface may be contoured to obtain a particular configuration for the formed joint **14***b*.

FIGS. **8–10** illustrate the invention in which the bonding agent **55***c* fully encompasses the hair **12***c* in the form of a ring at one end thereof. The bonding agent **55***c* may be applied when the hairs **12***c* are produced on an automatic process as by dipping the ends thereof. As seen in FIG. **8**, the bonding agent **55***c* is brought into overlapping relationship in the area **14***c* with the hair **11***c* extending from the scalp **10***c*. The junction portion **14***c* is positioned between the member of the supporting means **25***c* and tool member **20***c* such that when the energy and compressive force is applied the hair **11***c* is embedded within the bonding agent **55***c* as seen in FIGS. **9** and **10**. In this manner the bonding agent **55***c* essentially encapsulates respective portions of the hair to form a permanent bond.

FIG. **11**, illustrates the invention in which a multiple number of hairs **12***d* may be joined at a junction **14***d* to an existing hair **11***d* extending from the scalp **10***d*. In this manner the degree of hair thickness may be controlled. At each junction one or more hairs may be simultaneously joined together. When two hairs are joined together, and a bonding agent is used, then the hairs **12***d* may be provided as a separate assembly with an axial clearance hole through which the natural hair may first be threaded and then positioned at a desired distance from the scalp **10***d* between the supporting means **25***d* and tool member **20***d* while the latter is vibrated in the direction of arrow **22***d*.

FIG. **12** illustrates the invention wherein the bonding agent **55***e* may be applied internally to the hollow core or cavity **58***e* of either the hair **11***e* and/or **12***e*. As the ultrasonic mechanical energy is applied the bonding agent may pass through the wall of the hairs and provide a deposit therebetween to form the junction portion **14***e*. The hairs are positioned in overlapping relation and compressed between the tool **20***e* and supporting means **25***e* as the energy is applied in the direction of arrow **22***e*. The joined hair **12***e* may be artificial in that it is manufactured from a plastic or other material, or it may be human hair.

FIGS. **13** and **14** illustrate the invention in which the artificial hair **12***f* is made from a plastic material and when it is attached to the live hair **11***f* a certain flow thereof occurs in the junction area **14***f*. The vibratory energy when applied with the compressive force causes a flow of the hair **12***f* until it encompases the hair **11***f* and a firm bond is obtained.

CONCLUSION

Accordingly, applicant has invented and disclosed herein a new and novel process and apparatus that may be used commercially, as well as in the home, for the attachment of commercial hair to live hair to obtain a thickening thereof. In addition commercial hair may be secured to commercial hair using this invention as in the manufacture of hairpieces.

Although the commercial hair has generally been illustrated as solid, it is appreciated that it may be tubular if desired and telescopically associated with a live hair and joined with ultrasonic energy to obtain the same desired end results within the scope of the invention.

Many other changes could be effected in the particular constructions, and in the methods of use and construction, and in specific details thereof, hereinbefore set forth, without substantially departing from the invention intended to be defined herein, the specific description being merely of preferred embodiments capable of illustrating certain principles of the invention.

I claim:

1. The method of securing supplemental hairs to the existing hairs on top of the head, comprising the steps of:

A. selecting a human hair to which a supplemental hair is to be joined,

B. positioning a supplemental hair adjacent said human hair,

C. compressing the hairs together to form an area of overlap, and

D. simultaneously introducing ultrasonic mechanical vibrations into said area of overlap to bond said hairs together, and

E. terminating said ultrasonic vibrations at the end of a predetermined time period.

2. The method as defined in claim **1**,

a. wherein said step of compressing the hairs together is obtained by applying a member to each of said respective hairs and bringing said members towards each other, and

b. wherein said step of introducing ultrasonic mechanical vibration is obtained by vibrating one of said members.

3. The method as defined in claim **1**, wherein said ultrasonic vibrations are in the range of 5,000 c.p.s. to 100,000 c.p.s.

4. The method as defined in claim **1**, and further including the step of applying a bonding agent to one of said hairs in the area to be joined prior to the step of compressing same.

5. The method as defined in claim **4**, wherein said bonding agent is of a thermoplastic material adapted to become softened with the application of the high frequency energy thereto, whereby the hairs become joined to said bonding agent which solidifies after the termination of the vibrations.

6. The method as defined in claim **4**, wherein said bonding agent is externally applied.

7. The method as defined in claim **4**, wherein said bonding agent is internally applied.

8. The method as defined in claim **4**, wherein said bonding agent is applied to substantially the end of the supplemental hair.

9. The method as defined in claim **4**, wherein said bonding agent encapsulates said hairs in their area of overlap.

10. The method as defined in claim **1**, wherein the high-frequency vibration has a component substantially normal to the axis of said hairs.

11. The method as defined in claim **1**, wherein said mechanical vibration is applied to the area of overlap through one of said hairs.

12. The method as defined in claim **1**, wherein said energy is applied directly to the area of overlap.

13. The method as defined in claim **1**, and further including the step of retaining said hairs in relatively fixed relation to each other prior to the application of said ultrasonic vibrations.

14. The method as defined in claim **10**, wherein said ultrasonic mechanical vibration has a component substantially normal to the axis of said hairs.

15. The method of securing supplemental hairs to the existing hairs on top of the head, comprising the steps of:

A. selecting a human hair to which a supplemental hair is to be joined,

B. applying a bonding agent capable of being activated by ultrasonic mechanical vibrations to one of said hairs in the area to be joined,

C. overlapping portions of said hairs in the area to be joined,

D. positioning said overlapping portions between a tool member and a support member,

E. compressing said hairs between said tool member and said support member,

F. simultaneously vibrating said tool member at an ultrasonic rate to apply an additional compressive and energy producing forces at said area of overlap, and

G. continuing the application of said compressive and energy producing forces until said hairs become joined to said activated bonding agent.

16. The method as defined in claim **15**, and further including the step of retaining said hairs in relatively fixed relation to each other prior to the application of said ultrasonic vibrations.

17. The method as defined in claim **15**, and further including the step of terminating said ultrasonic vibrations at the end of a predetermined time period.

18. The method as defined in claim **15**, wherein said bonding agent is externally applied.

19. The method as defined in claim **15**, wherein said bonding agent is internally applied.

20. The method as defined in claim **15**, wherein said bonding agent is applied to substantially the end of the supplemental hair.

21. The method as defined in claim **15**, wherein said bonding agent encapsulates said hairs in their area of overlap.

22. The method as defined in claim **15**, wherein said ultrasonic vibrations are in the range of 5,000 c.p.s. to 100,000 c.p.s.

23. The method as defined in claim **22**, wherein said ultrasonic vibrations are preferably in the range of 20,000 c.p.s. to 60,000 c.p.s.

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