United States Patent [19]

Kuris

[11] **3,727,619**

[45] **Apr. 17, 1973**

[54] **ULTRASONIC APPARATUS FOR HAIR JOINING**

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

[22] Filed: **Sept. 14, 1971**

[21] Appl. No.: **180,423**

Related U.S. Application Data

[62] Division of Ser. No. 885,830, Dec. 17, 1969, Pat. No. 3,642,010.

[52] **U.S. Cl.** **132/56,** 156/73

[51] **Int. Cl.** **B29c 27/08**

[58] **Field of Search** 132/56; 156/580, 156/73; 228/1

[56] **References Cited**

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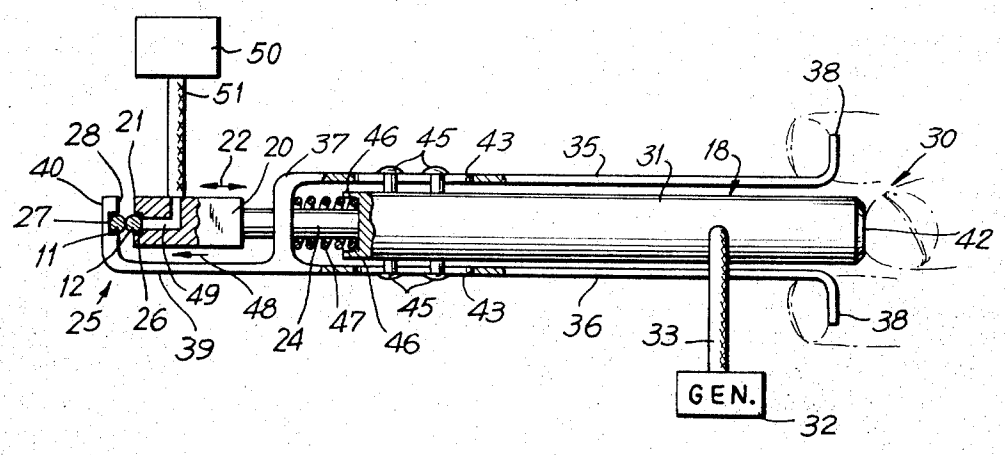
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Assistant Examiner—J. N. Eskovitz
Attorney—Leonard W. Suroff

[57] **ABSTRACT**

The method and apparatus 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.

11 Claims, 14 Drawing Figures



PATENTED APR 17 1973

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SHEET 1 OF 3

FIG. 1

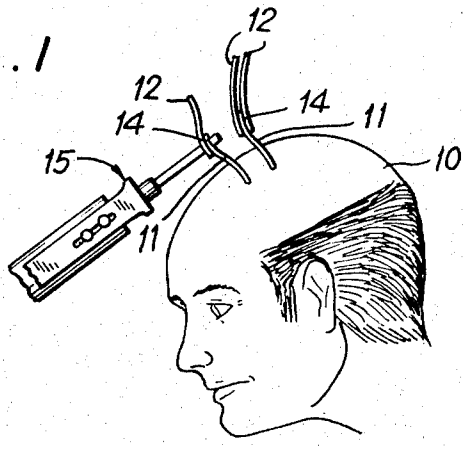


FIG. 2

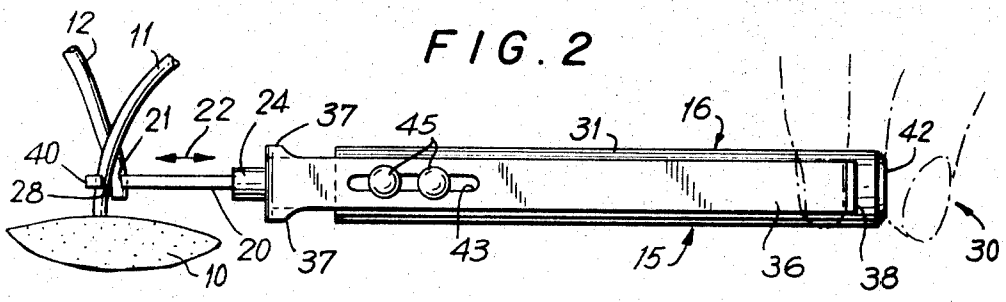


FIG. 3

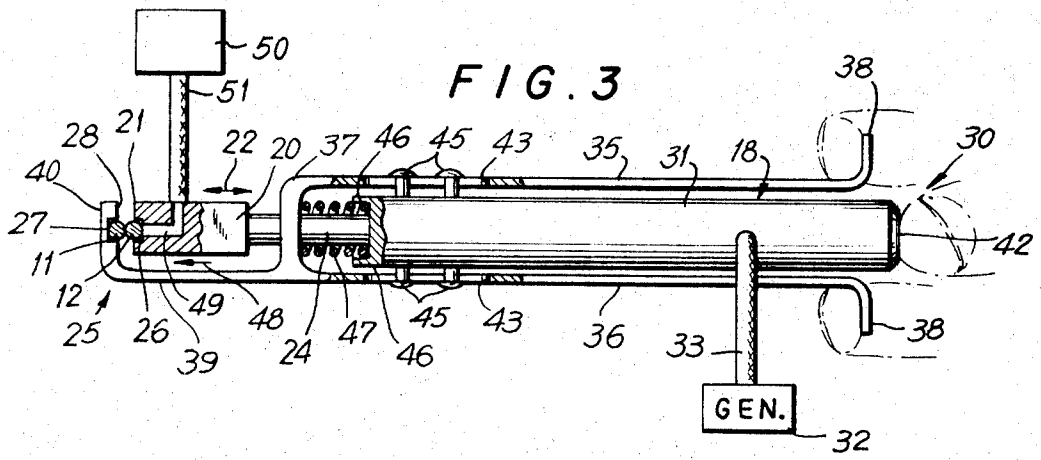
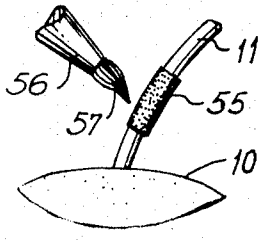


FIG. 4



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FIG. 5

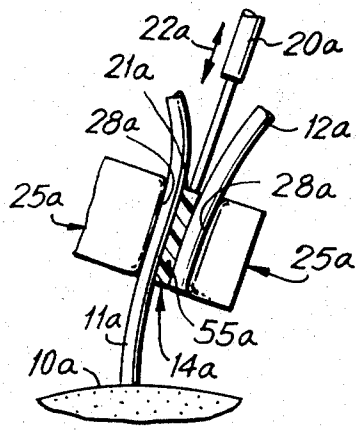


FIG. 6

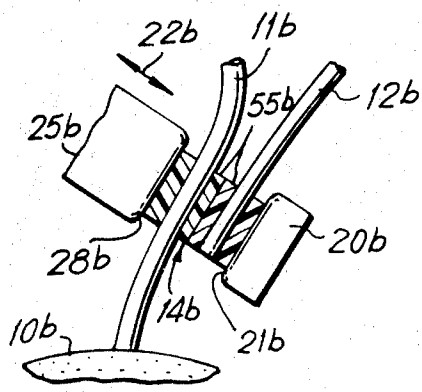


FIG. 7

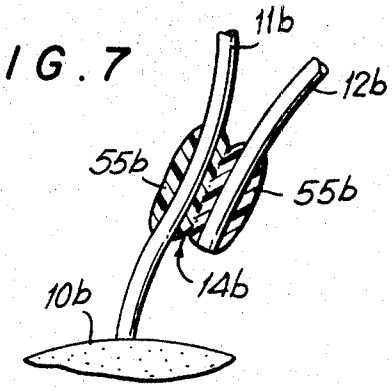


FIG. 8

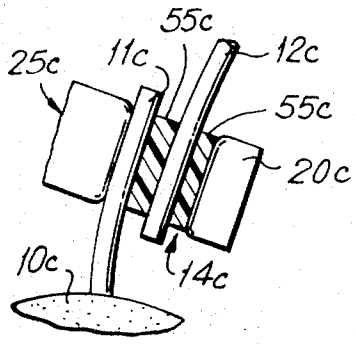


FIG. 9

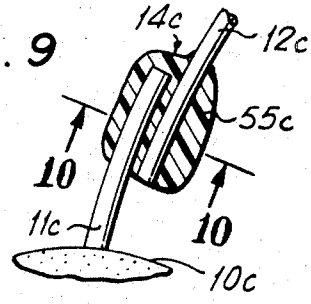
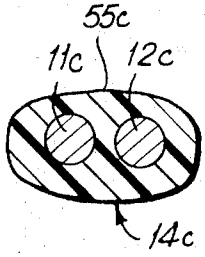


FIG. 10



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FIG. 11

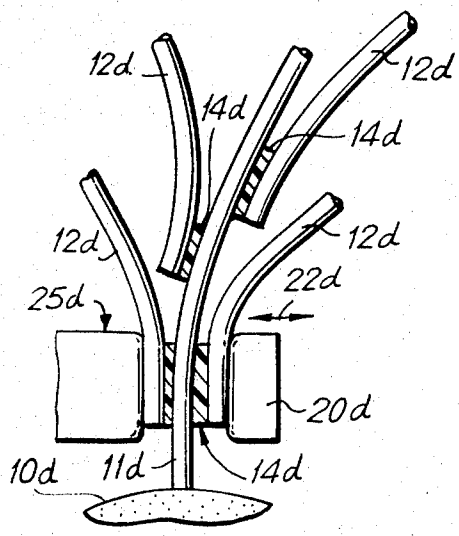


FIG. 12

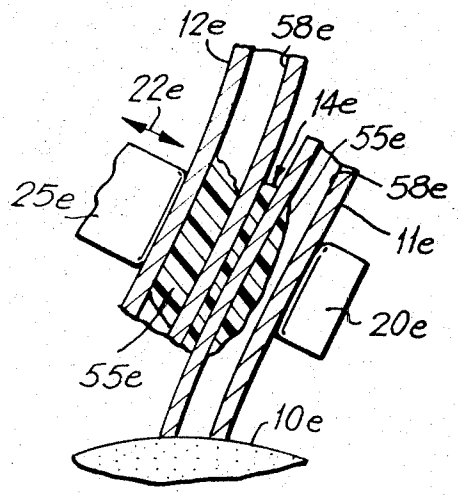
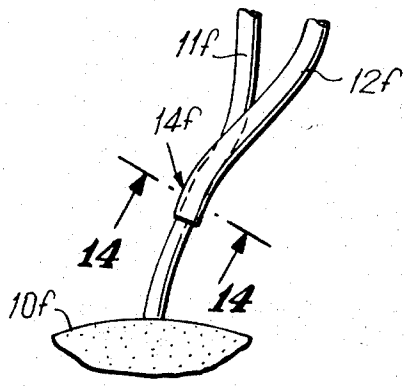


FIG. 13



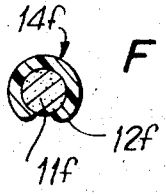


FIG. 14

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ULTRASONIC APPARATUS FOR HAIR JOINING

CROSS-REFERENCE TO RELATED APPLICATION

This is a division of application Ser. No. 885,830, filed Dec. 17, 1969 now U.S. Pat. No. 3,642,010.

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. Ultrasonic 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 generally 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 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 in 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 inter-changeable with other work performing tools in accoustically 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 hyper-accelerations 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.

It 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 biassed 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 spacially 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 semi-permanent 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 side wall 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 inches.

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 terminated. 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 encompases 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 **14e**. 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 hair pieces.

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. A hand held instrument for joining together overlapping portions of supplemental hairs and existing hairs on top of the head, comprising:

a. a tool member having a working surface for contact with one of the hairs to be joined,

b. transducer means operative to vibrate said working surface of the tool member at a high frequency of at least 5,000 cycles per second and low amplitude,

c. supporting means having a support surface for contact with the opposite hair to be joined, and

d. means for mounting said supporting means with respect to said transducer means in a manner to permit relative displacement of said working and support surface towards and away from each other for engagement with the opposite sides of the overlapped hairs for applying a compressive force thereto, wherein the overlapped portions of hair are joined together by the combined action of the applied compressive force and ultrasonic vibrations,

e. said tool member having a channel extending therein and terminating at one end of said working surface, means in communicating relation with said channel for supplying a bonding agent through said channel to one of said hairs in their area of overlap, said bonding agent becoming softened with the application of ultrasonic energy thereto and flowing from said tool onto the contacted hair, and

f. said supporting means includes means for gripping the instrument by the hand of the user to permit manual control of the relative displacement between said overlapping working and support surfaces.

2. A hand held instrument as claimed in claim **1**, and further including positioning means associated with said supporting means to maintain said hairs in relatively fixed position to each other during the application of said ultrasonic vibrations.

3. A hand held instrument as claimed in claim **2**, wherein said positioning means includes a slot on said supporting means.

4. A hand held instrument as claimed in claim **1**, further including spring means yieldably urging said support means and transducer means for relative movement with respect to each other.

5. A hand held instrument as in claim **4**, wherein said relative movement is to a position wherein said working and support surface are normally in engagement with each other under a predetermined static force, whereby said supporting and transducer means are first separated for the placement of the hairs therebetween.

6. A hand held instrument as claimed in claim **1**, wherein

a. said transducer means is contained in a housing, and

b. said supporting means further includes a pair of spaced apart legs on opposite sides of said transducer housing in fixed spaced relation to each other with said gripping means extending from one end of said legs, and one of said legs at its opposite end terminating in a support arm containing said support surfaces.

7. A hand held instrument for joining together overlapping portions of supplemental hairs and existing hairs on top of the head comprising:

a. supporting means having a surface for supporting the overlapping portions thereon,

b. positioning means communicating with said supporting surface for retention of said overlapping portions in said overlapping relationship,

c. a tool member having a working surface for contact with said overlapping portions,

d. transducer means operative to vibrate said working surface of the tool member at a high frequency of at least 5,000 cycles per second,

e. means for mounting said supporting means with respect to said transducer means in a manner to permit relative displacement of said working and supporting surface towards and away from each other for engagement with the opposite sides of the overlapping portions for applying a compressive force thereto, and , wherein said relative displacement is to a position wherein said working and support surfaces are normally in engagement with each other under a predetermined static force, whereby said supporting and transducer means are first separated for placement of the hairs therebetween,

f. said tool member having a channel extending therein and terminating at one end of said working surface, means in communicating relation with said channel for supplying a bonding agent through said channel to one of said hairs in their area of overlap, said bonding agent becoming softened with the application of ultrasonic energy thereto and flowing from said tool onto said hair, and

g. said supporting means includes means for gripping the instrument by the hand of the user to permit manual control of the relative displacement between said overlapping working and support surfaces.

8. A hand held instrument as claimed in claim **7**, wherein said vibrations are applied in a direction substantially parallel to the direction in which the compressive force is applied to said overlapping portions.

9. A hand held instrument as claimed in claim **7**, further including spring means yieldably urging said support means and transducer means for relative movement with respect to each other.

10. A hand held instrument as claimed in claim **7**, wherein said positioning means includes a slot on said supporting means.

11. A hand held instrument as claimed in claim **7**, wherein

a. said transducer means is contained in a housing, and

b. said supporting means further includes a pair of spaced apart legs on opposite sides of said transducer housing in fixed spaced relation to each other with said gripping means extending from one end of said legs, and one of said legs at its opposite end terminating in a support arm containing said support surface.

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