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(54) HAIR EXTRACTION DEVICE AND METHOD FOR ITS USE

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(57) ABSTRACT

The harvesting of hair for a hair transplant procedure employs a hollow drill with an imaging system which permits alignment of center of the cutting edge of a hollow tube with the axis of the follicular unit to be removed. The diameter of the hollow tube is chosen such that when properly aligned, a follicular unit is removed without damaging critical anatomical portions of the follicles. In one embodiment, a medium in either liquid or vapor form is introduced to cool or freeze the skin over the surface of the selected follicular unit. In another embodiment, suction is applied to aid in the removal of the excised follicular unit. In still another embodiment, a robotic arm is employed to position the hollow needle in each instance. In another embodiment, an electrical current or heat is applied to kill the shaft of the selected follicular unit without its removal.

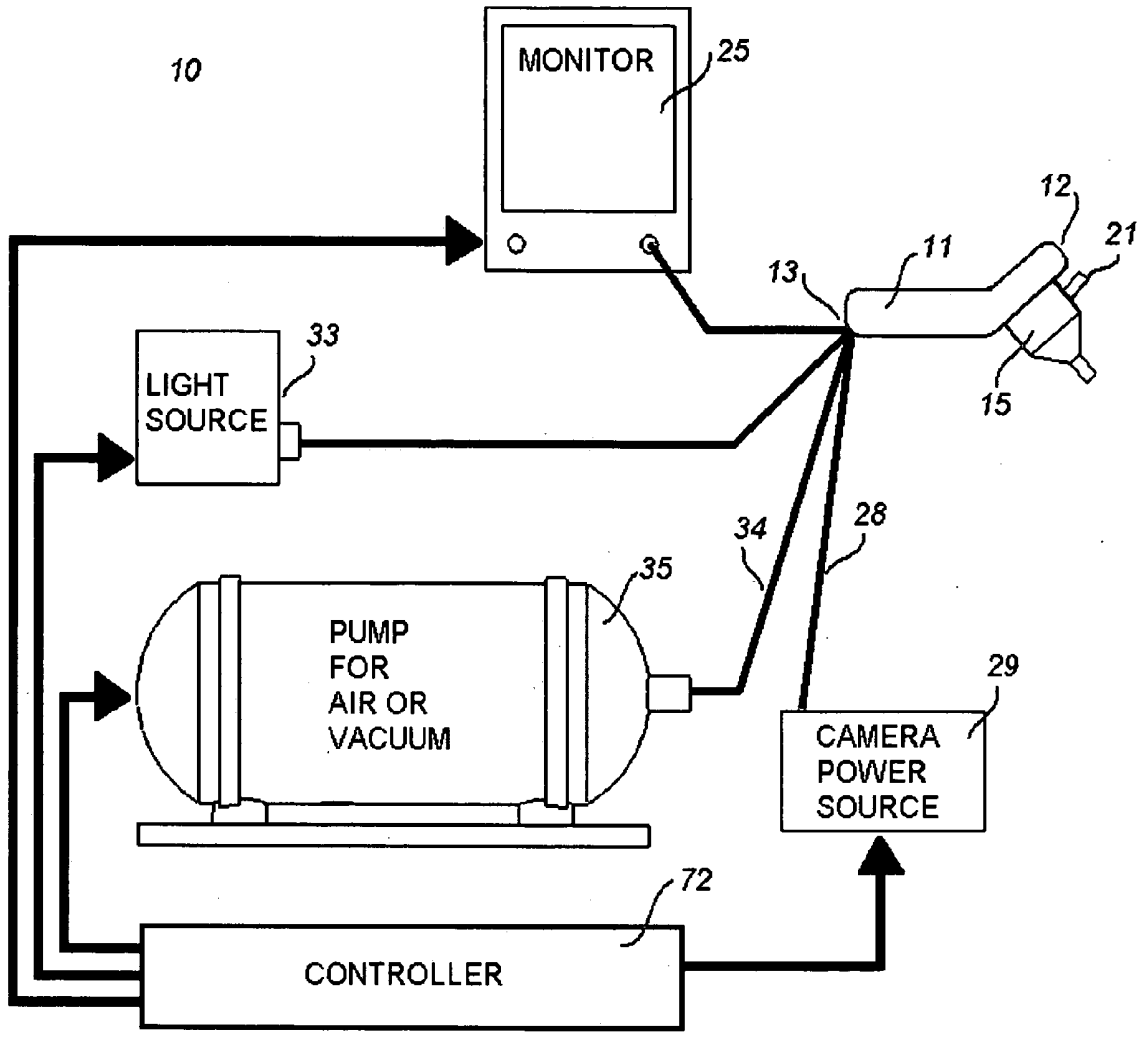


Fig. 1

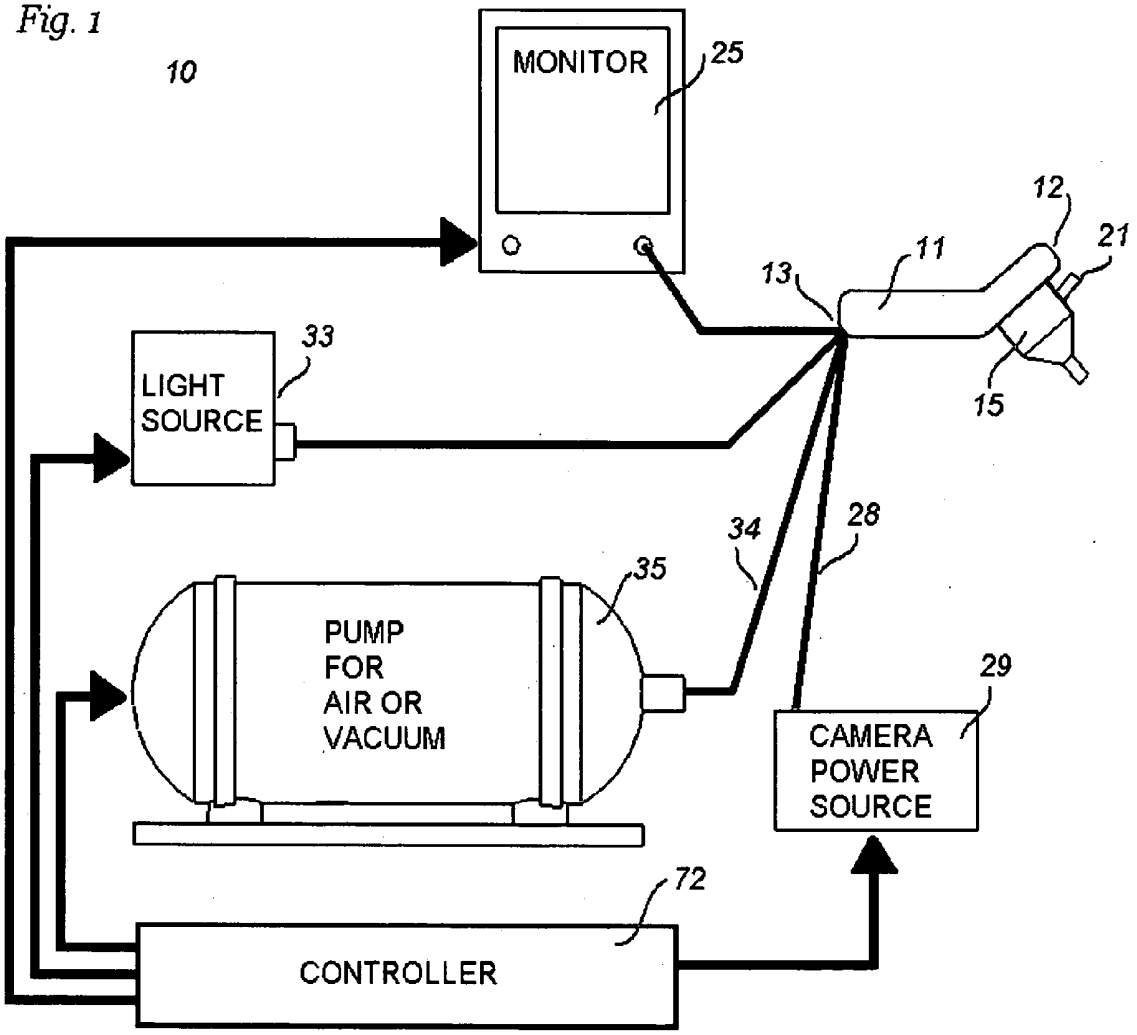

10
MONITOR
25
12
21
11
13
LIGHT SOURCE
33
15
34
28
35
PUMP FOR AIR OR VACUUM
29
CAMERA POWER SOURCE
72
CONTROLLER

Fig. 2

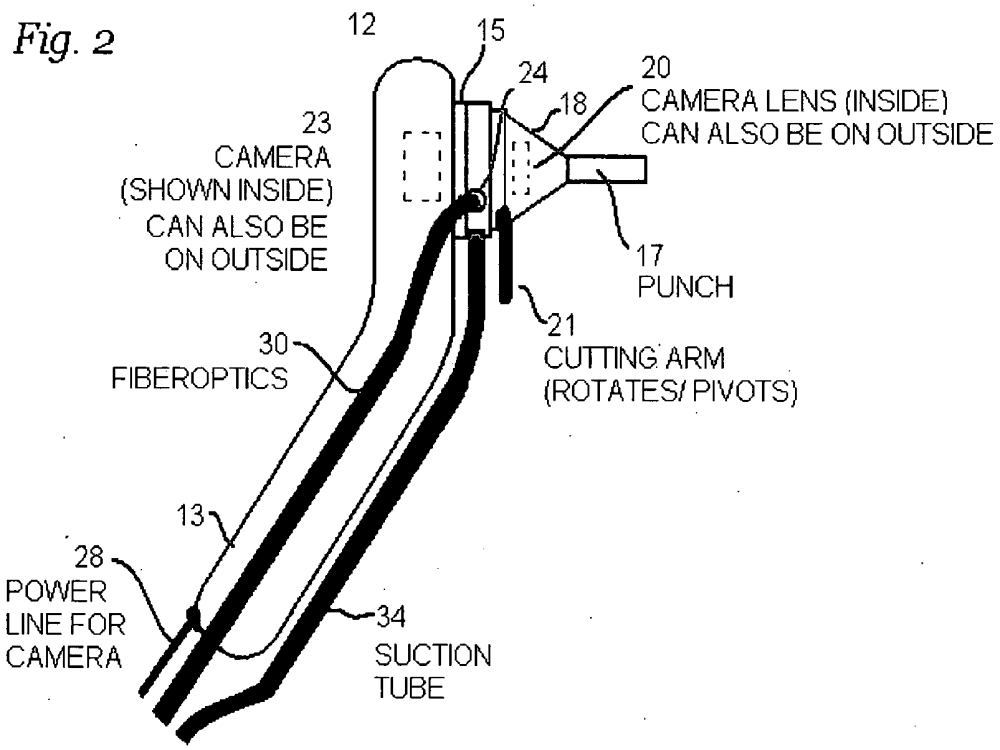

12
15
24
20
CAMERA LENS (INSIDE)
CAN ALSO BE ON OUTSIDE
18
23
CAMERA
(SHOWN INSIDE)
CAN ALSO BE
ON OUTSIDE
17
PUNCH
21
CUTTING ARM
(ROTATES/ PIVOTS)
30
FIBEROPTICS
13
28
POWER
LINE FOR
CAMERA
34
SUCTION
TUBE

Fig. 3

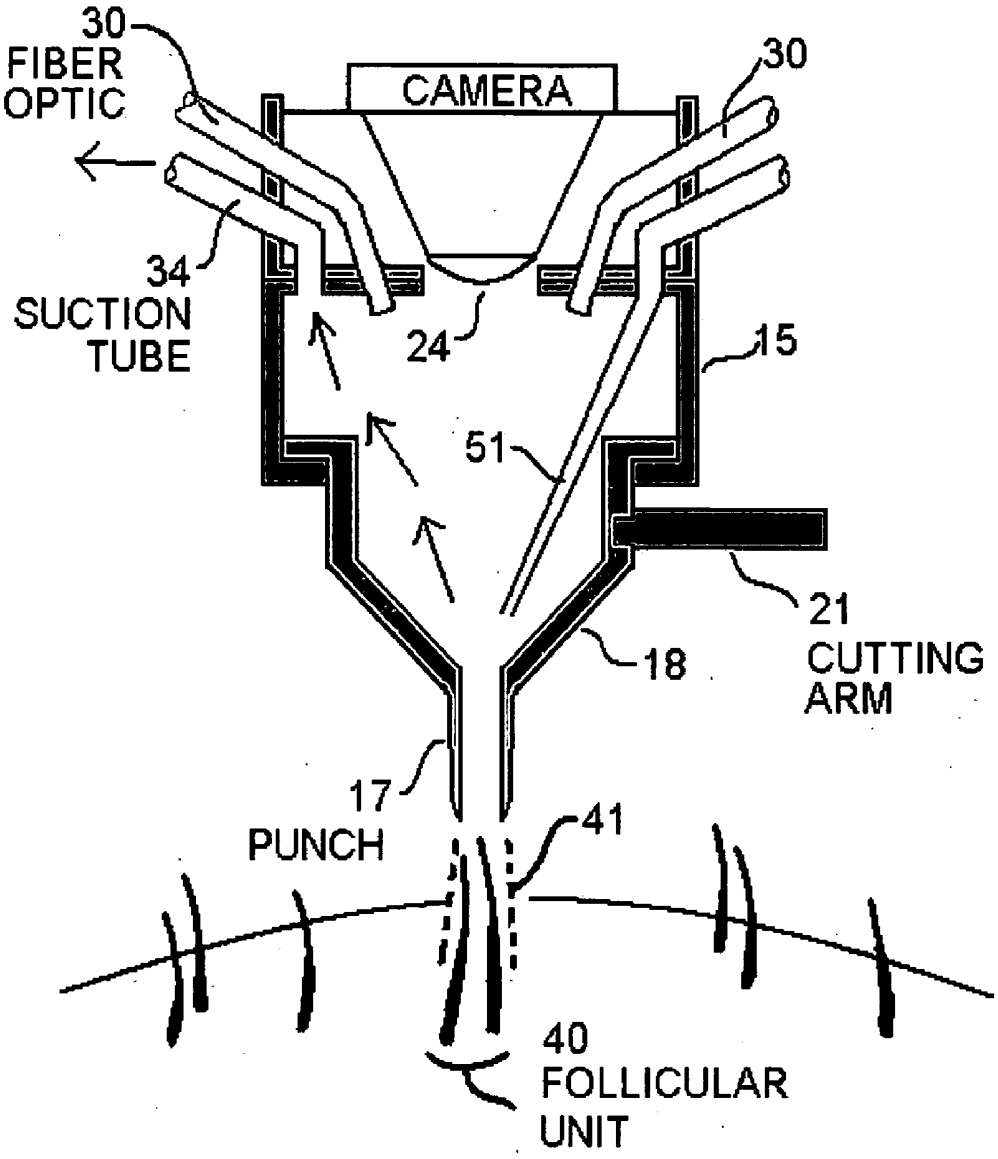

30
FIBER
OPTIC
CAMERA
30
34
SUCTION
TUBE
24
15
51
21
CUTTING
ARM
18
17
PUNCH
41
40
FOLLICULAR
UNIT

Fig. 4

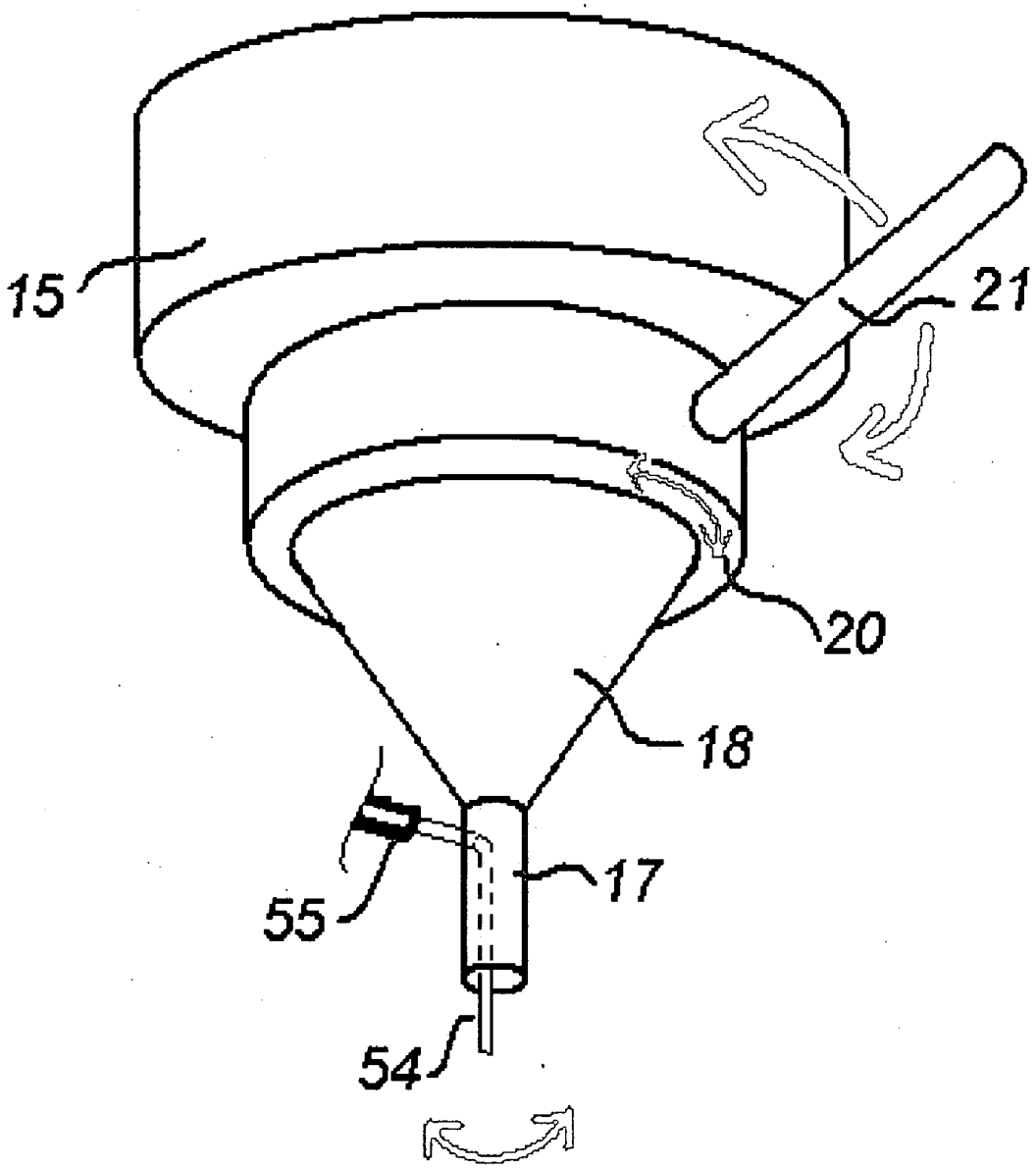


Fig. 5

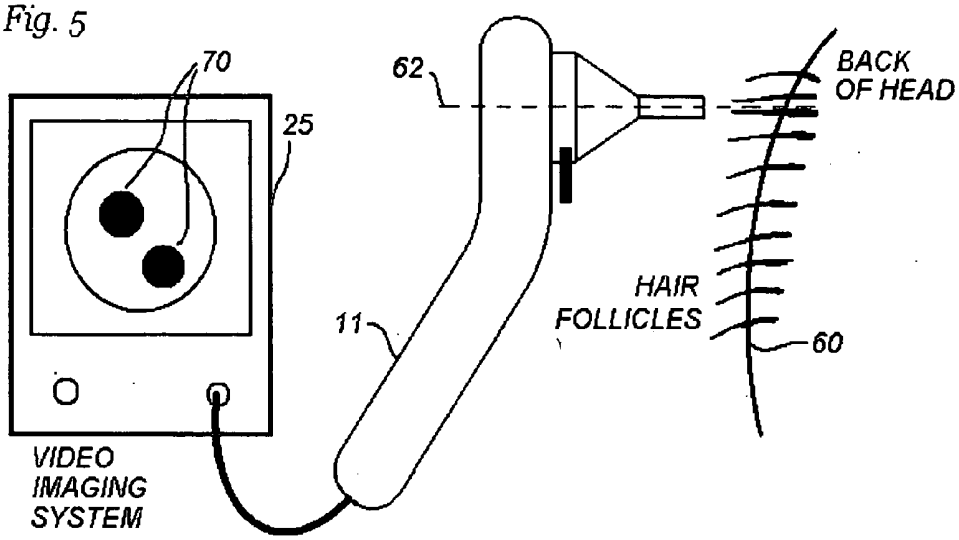

70
25
62
BACK
OF HEAD
11
HAIR
FOLLICLES
60
VIDEO
IMAGING
SYSTEM

Fig. 6

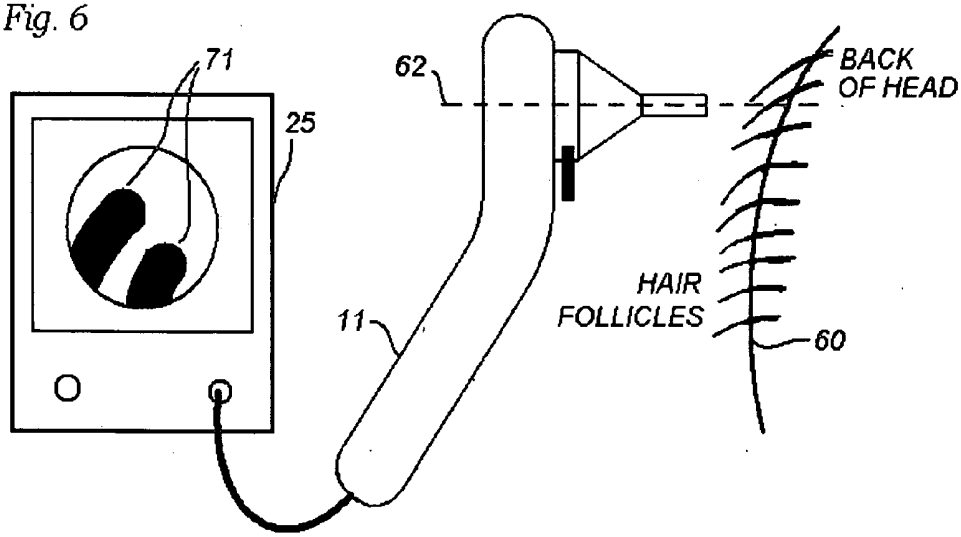

71
25
62
BACK
OF HEAD
11
HAIR
FOLLICLES
60

Fig. 7

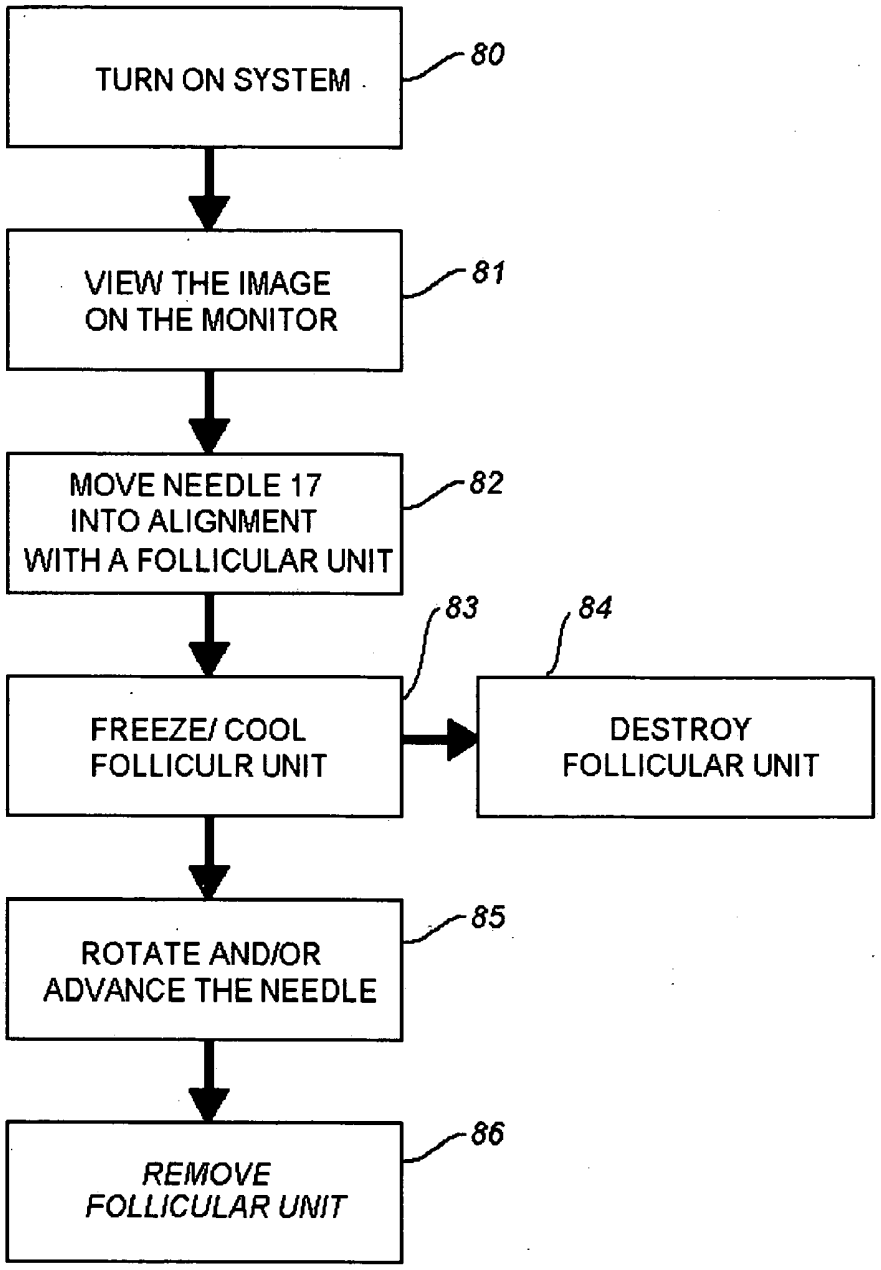
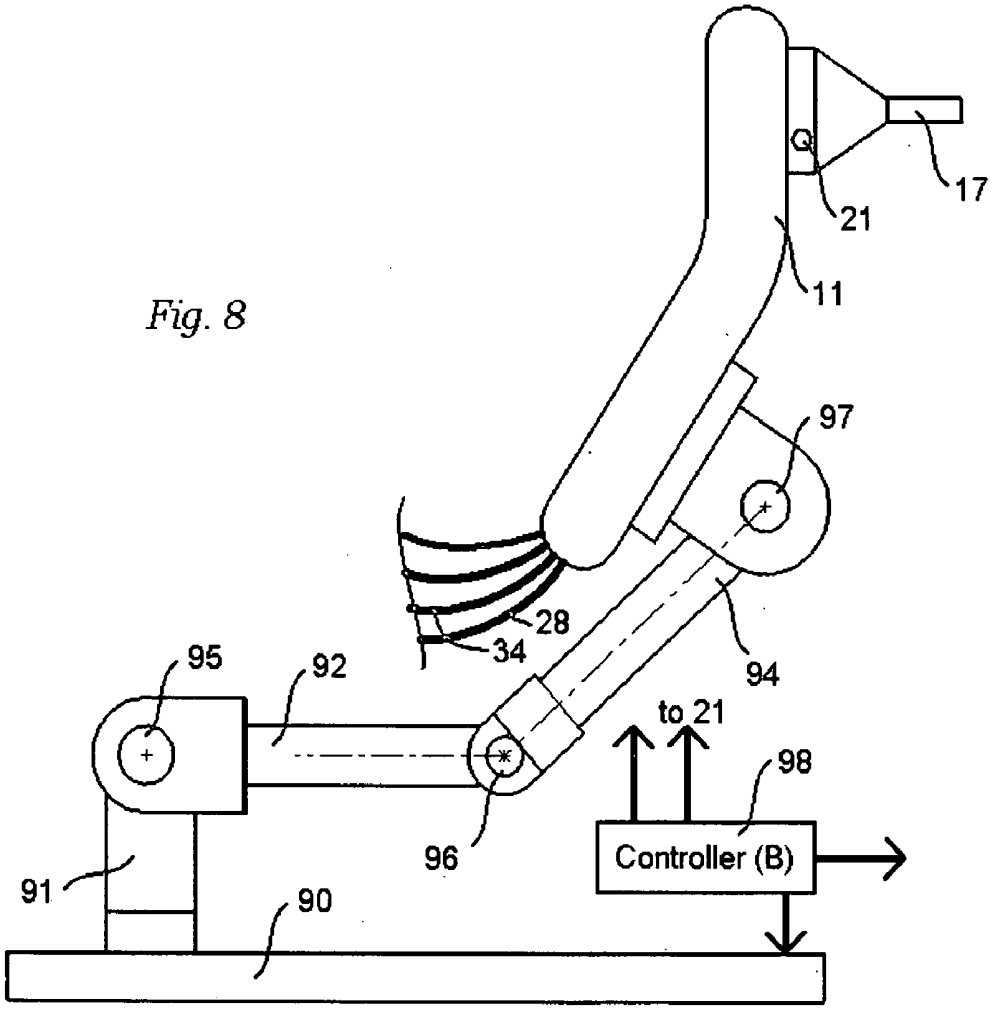

TURN ON SYSTEM
80
VIEW THE IMAGE ON THE MONITOR
81
MOVE NEEDLE 17 INTO ALIGNMENT WITH A FOLLICULAR UNIT
82
FREEZE/ COOL FOLLICULR UNIT
83
DESTROY FOLLICULAR UNIT
84
ROTATE AND/OR ADVANCE THE NEEDLE
85
REMOVE FOLLICULAR UNIT
86

Fig. 8



HAIR EXTRACTION DEVICE AND METHOD FOR ITS USE

RELATE APPLICATION

[0001] The present application is related to U.S. Pat. No. 6,572625 B1, issued Jun. 3, 2003, included by reference herein.

FIELD OF THE INVENTION

[0002] This invention relates to the isolation and or extraction of hair follicles from an area and more particularly to a device for controllably positioning an instrument for removing follicular units of hair and stabilizing the hair bearing skin and its layers.

BACKGROUND OF THE INVENTION

[0003] Hair transplant procedures have been carried out for decades. Initially, a punch was used to remove a circular area of hairy skin containing ten or more follicular units (of 1-3 hairs each). The area of hairy skin replaced a like area of bald skin removed from the patient. Several of such "plugs," were placed into areas in the bald part of the head.

[0004] The circular punch tool was later replaced by a hollow powered drill and the space left in the donor area was left to heal naturally. Both of these prior art procedures allowed wounds to stay open for weeks at a time exposing a patient to the discomfort from large wounds measuring 3-5 millimeters in diameter.

[0005] Today's standard procedure often referred as follicular unit extraction is done with a "punch" that is around 1 millimeters in diameter which leaves virtually no scar and promotes faster healing times due to the small size of the wound. It is a more aesthetically pleasing procedure because the transplanted hair is in its natural follicular unit grouping of 1 to 3 hairs.

[0006] The problem with today's follicular unit extraction is that it is difficult to harvest one follicular unit at a time because of the inherent variability of individual patient's skin and hair characteristics. Working with a follicular extraction tool that is about 1 mm in diameter gives a narrow margin of error for the surgeon.

[0007] Other solutions to the "punch" or drilling method of harvesting hair follicles is to excise a strip of skin containing the donor hair using a scalpel. This strip of skin is processed by mean of dividing up and separating individual hair follicles preferably under a dissecting microscope. Thus the harvesting of individual hair follicles is carried out separately outside the human body. The resulting wound from the strip of skin that was excised is closed with sutures or staples.

[0008] Shortcomings of the strip excision include longer healing time and unavoidable linear scar. This linear scar is sometimes seen as the stigmata of a hair transplant surgery.

SUMMARY OF THE INVENTION

[0009] In accordance with the principles of the present **0**invention, a hollow instrument with a cutting or dissecting edge such as a drill or punch or needle (sharp or dull) with a diameter slightly larger than a follicular unit is used to cut into the skin. The instrument includes an imaging system such as a video system which allows the health care professional to align the instrument along the axis of the follicular unit and to produce a cutting action outside of the follicular unit's critical anatomical parts. As the wound is very small, this results in relatively fast healing, less bleeding and virtually no grossly visible scar tissue formation.

[0010] The invention is based on the recognition that a follicular unit can be harvested by freezing or cooling the superficial area of the follicular unit to facilitate the harvesting process. A similar process can be employed to kill a hair follicle by inserting a needle for delivering an electric current or by delivering a high ultrasound signal to the growth centers along the hair shaft. When used as a harvesting tool, the freezing or cooling of the localized area of skin results in a superficial freeze or cooling around the targeted follicular unit, stabilizing the follicular unit in the 'frozen skin' facilitating the removal of the follicular unit as detailed in Pat. No. 6,572,625 B1 issued Jun. 3, 2003.

[0011] The freezing or cooling of the dermal layer surrounding a follicular unit to be excised has been found not only to be simpler to implement but also to facilitate the removal of the unit even more than the introduction of fluid under the skin as described in the above-noted patent. When used for hair destruction, it has been found advantageous to align and stabilize the shaft of the follicular unit in order to disrupt the growth center of the follicular unit, thereby killing it.

[0012] In accordance with one embodiment of this invention, the instrument of FIG. **1** is adapted to apply a liquid or air to relatively cool the follicular unit being viewed to near freezing or freezing temperature. The cooling of a follicular unit prior to excising the unit, after it is aligned, not only stabilizes the deeper dermal structures with respect to the more superficial structures, but does so in a manner to anesthetize the area and allow removal with virtually no damage to surrounding areas.

[0013] In accordance with another embodiment a multiple dimensional stabilization gantry is employed to fix the hollow instrument and thus the imaging system. Such a ,device can be done without direct human involvement, acquiring the appropriate orientation for follicular unit extraction or destruction based upon the same technology as described in the aforementioned patent. In still another embodiment a suction device is positioned to create traction and or better field of view along the follicular unit to ensure that cutting proceeds only to a prescribed path and or depth.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a schematic block diagram of a hair transplant harvesting device in accordance with the principles of this invention;

[0015] FIG. **2** is a schematic side view of a hand-held portion of the system of FIG. **1**;

[0016] FIGS. **3** and **4** are enlarged schematic cross sectional and perspective views of a subassembly of the hand-held portion shown in FIG. **2**;

[0017] FIGS. **5** and **6** are representations of video images produced by the apparatus of FIGS. **1-4**; and

[0018] FIG. **7** is a flow diagram of the method practiced by the system of FIGS. **1-7**, and

[0019] FIG. **8** is a schematic side view of a robotic subassembly for excising follicular units from a donor area;

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS OF THIS INVENTION

[0020] FIG. **1** is a block diagram of a system **10** in accordance with this invention. The system includes an instrument **11** having a proximal end and a distal end **12** and **13** respectively. A tubular shaped subassembly **15** extends from the proximal end of the instrument.

[0021] FIG. **2** is an enlarged schematic side view of instrument **11**. Subassembly **15** can be seen to have a general shape similar to that of an instrument commonly used to examine the human ear. The subassembly includes a hollow needle or punch **17** and a conical section **18** which enlarges in diameter as it extends upwards and to the left as viewed in the figure.

[0022] The end of section **18** with the relatively large diameter is coupled to the cylindrical portion of the subassembly by a rotating member or lip **20**. Rotating member **20** is operated by cutting arm **21** and serves to extend (or advance) hollow needle **17** when rotated.

[0023] Instrument **11** includes a solid state camera such as a charge-coupled device (CCD) camera represented by dashed rectangular line **23** shown in FIG. **2**. Subassembly **15** also includes a lens **24**. The camera and lens are components of an imaging system positioned to capture an image via the hollow needle and to display that image on monitor **25** of FIG. **1**. Power for the CCD camera is provided via cable **28** of FIGS. **1** and **2** from power source **29** of FIG. **1**.

[0024] Illumination of the field of view for the camera is supplied via optical fibers **30** extending from subassembly **15** to light source **33** of FIG. **1**.

[0025] In one embodiment of the invention, a suction tube **34** also is provided. Tube **34** extends between subassembly **15** and an air pump **35** shown in FIG. **1**. Suction may be provided to assist in extracting a follicular unit when arm **21** is rotated by a user to advance hollow needle **17** into the skin of a patient.

[0026] FIG. **3** shows an enlarged cross section of subassembly **15** showing the relative position of lens **24**, optical fibers (**30**), suction tube **34**, hollow needle **17**, conical section **18**, and rotating member **20** with cutting arm **21**. FIG. **4** shows an enlarged perspective view of subassembly **15** showing hollow needle **17**, conical section **18**, rotating member **20** with cutting arm **21**. It is clear from the views of FIGS. **3** and **4** that a user observes a follicular unit **40** as shown in FIG. **4** by moving instrument **11** (FIG. **1**) until a selected follicular unit is in the center of the field of view **41**. The user observes the field of view in monitor **25** of FIG. **1**. The diameter of hollow needle **17** is chosen sufficiently wide to cut past beyond the critical anatomical structures of a follicular unit thus avoiding any damage to the unit.

[0027] The instrument as shown in FIG. **3** also is adapted to include a reservoir of, for example, liquid nitrogen or ethylene dioxide for freezing the follicular unit (**40**) in view. Tube **51** is shown in FIG. **3** to indicate a supply of the freezing material if the material is of a type to require maintenance under pressure and/or is not sufficiently transparent to avoid obstructing the viewing of the follicular unit (**40**).

[0028] It has also been found under certain conditions or circumstances to kill or neutralize the hair shaft of the follicular unit to be excised. The follicular unit is killed or neutralized conveniently by inserting a needle into the follicular unit and delivering an electric current for a predetermined period of time to in essence neutralize or kill the growth center of the follicular unit. FIG. **4** shows a needle **54** connected via conductor **55** for this purpose. The conductor is connected to a power source not shown. The electrical current can be initiated by the movement of arm **21** under the control of a controller represented by block **72** shown in FIG. **1**.

[0029] Alternatively, needle **54** could be adapted to supply ultrasound energy to accomplish the same goal of neutralizing or killing the follicular unit.

[0030] Once the follicular unit is frozen, excising of the unit may proceed.

[0031] FIGS. **5** and **6** show the image of a representative follicular unit when instrument **11** is aligned with the unit and when it is not respectively. Both FIGS. **5** and **6** represent the back of a patient's head **60** with hair follicles extending downwards and to the left as viewed. In FIG. **5** instrument **11** is seen to align its axis **62** and the hair follicles are not aligned. The resulting images in monitor **25** are dots **70** and lines **71** respectively.

[0032] The various components of the system of FIG. **1** may be any components capable of operating as described. The operation of the component is controlled by a controller represented by block **72** of FIG. **1**.

[0033] FIG. **7** is a flow diagram of the method practiced by the system of FIG. **1**. The system is used with a patient having a shaved head so that the donor area of the head exhibits erect hair follicles. A user positions the hollow needle over the skin of a patient after turning on the monitor, the light source and the camera. The procedure starts by turning on the system as represented by block **80** of FIG. **7** and the image of the field of view is observed on the monitor (**25**) as indicated by block **81**.

[0034] The user moves the instrument (**11**) until the field of view (illustratively through the needle) is in alignment with a follicular unit producing an image as shown in FIG. **5**. This step is represented by block **82**.

[0035] The instrument is now properly positioned with the top of the needle juxtaposed against the skin of a patient with a selected follicular unit in the field of view and with the axis of the needle aligned with the axis of the follicular unit. The user now administers the freezing material and then applies a current to kill the shaft of the follicular unit in view as shown by blocks **83** and **84**. The user now moves arm **21** to advance the needle while rotating the cutting edge of the needle to excise the unit. The rotation of the needle and the removal of the unit are represented by blocks **85** and **86**.

[0036] The removal of the excised unit is expedited by the suction tube **34** and air pump **35** of FIG. **1**. But any suitable method of removal is adequate. Tweezers may be used, for example.

[0037] The spacing between adjacent follicular units varies randomly but typically is greater than one millimeter. The critical anatomical structure of a unit is only a fraction of that distance thus dictating a minimum diameter of 0.50 millimeters for the hollow needle. It is thus, convenient to secure an x/y/z gantry (not shown) to the head of a patient and to secure the "hand held" instrument so that it can be controlled by adjusting micromanipulators.

[0038] FIG. **8** is a schematic side view of a robotic subassembly for extracting follicular untis of hair from a donor area in the manner described in connection with FIGS.

1, 2, and 3. The robotic subassembly comprises of a positioning table 90 to which the instrument 11 of FIGS. 1, 2, and 3 is connected by means of Post 91. Positioning table 90 is operative to move post 91 in a X,Y,Z and rotational planes. Post 91 is operative to actuate arm 92 along and or around its axis. Instrument 11 is connected to Post 91 by arms 92 and 94 at pivot points 95, 96, and 97 which are set to adjust Punch 17 with a selected donor area.

[0039] The Operation is controlled by a controller 98 responsive to move punch 17 to a position shown in FIG. 5, to initiate a localized freezing of the follicular unit view and to advance the punch along its axis to a depth to excise or extract the follicular unit and to manipulate cutting arm 21 to facilitate the removal of the follicular unit.

[0040] The robotic subassembly of FIG. 8 may be adapted for administering a freezing or cooling step and/or a growth center destruction step as described in connection with FIGS. 3 and 4.

[0041] It is to be understood that the description herein is merely illustrative of the principles of this invention and that various changes and modifications thereof may be made by those skilled in the art within the spirit and scope of the invention as encompassed by the following claims: For example, any implementation for freezing a follicular unit in view, such as freezing air, a spray, a cold tip—etc may be used. Further, although the specification disclosed the use of a camera, any means for capturing the image may be used such as a digital reader.

What is claimed is:

1. Harvesting apparatus for the removal of a follicular unit of hair from an area of a patient for transplant to another area, said apparatus comprising a hollow instrument having a diameter with a cutting edge about equal to the diameter of critical anatomical parts of a follicular unit of hair, said apparatus including a mechanism for aligning said instrument with a selected follicular unit, means for cooling or freezing the skin surface around the selected follicular unit and means for advancing said instrument for cutting around the selected follicular unit.

2. Apparatus as in claim 1 wherein said mechanism for alignment includes video means for viewing the image produced by said system.

3. Apparatus as in claim 2 wherein said mechanism for alignment includes fiber optic means located within said instrument, said fiber optic means being energy coupled to a light source for illuminating a selected follicular unit with which said instrument is aligned.

4. Apparatus as in claim 2 wherein said mechanism for alignment includes a camera for capturing said image and means coupled to said camera for displaying said image on said video means.

5. Apparatus as in claim 1 wherein said instrument has a rotating element attached to a fixture, said mechanism for alignment includes a camera or imaging device located within said fixture, said fixture being fixedly attached to an elongated portion having dimensions for fitting a human hand.

6. Apparatus as in claim 5 wherein said system includes a camera for capturing said image and means coupled to said camera for displaying said image on said video means.

7. Apparatus as in claim 6 wherein said elongated portion has a proximal end, said proximal end having extended there from a chamber portion including said camera, said chamber portion having said hollow instrument axially aligned therewith.

8. Apparatus as in claim 1 wherein said means for cooling or freezing comprises means for introducing a medium in liquid or vapor form to the identified follicular unit.

9. Apparatus as in claim 8 also including suction means for removal of an excised follicular unit.

10. Apparatus as in claim 5 also including means for positioning said elongated portion with respect to a selected follicular unit.

11. A method of harvesting follicular units of hair for implanting, said method comprising the steps of positioning a hollow instrument having a cutting edge with a diameter about equal to the diameter of critical anatomical parts of a follicular unit of hair over a target area, aligning said instrument with the axis of a follicular unit to be excised, cooling or freezing about the follicular unit, inserting said instrument into the scalp or skin about the cooled or frozen skin surface of the follicular unit, advancing said instrument to cut the scalp or skin about the cooled or frozen skin surface of the follicular unit, and removing said follicular unit.

12. A method as in claim 11 wherein said step of aligning comprises capturing an image of said selected follicular unit, displaying said image on a video screen, to facilitate positioning said instrument along the axis of said selected follicular unit.

13. Harvesting apparatus as in claim 1 also including means for killing the shaft of a selected follicular unit.

14. Harvesting apparatus as in claim 13 wherein said means for killing the shaft comprises a needle adapted to deliver an energy source such as electric or ultrasonic or thermogenic or chemical.

15. A method as in claim 11 also including the step of killing the shaft of the frozen selected follicular unit.

16. Apparatus as in claim 4 wherein said means for aligning comprises of robotic subassembly.

17. Apparatus as in claim 1 wherein said system is connected to a robotic arm having extended there from a chamber portion including said camera or a digital reader, said chamber portion having said hollow instrument axially aligned therewith which moves in multiple dimensions for aligning hairs within a follicular unit to position for cutting around said follicular unit.

* * * * *

专利名称(译)	毛发提取装置及其使用方法		
公开(公告)号	US20080033455A1	公开(公告)日	2008-02-07
申请号	US11/462102	申请日	2006-08-03
[标]申请(专利权)人(译)	RASSMAN WILLIAM - [R PAK JAE P		
申请(专利权)人(译)	RASSMAN WILLIAM - [R PAK JAE P		
当前申请(专利权)人(译)	RASSMAN WILLIAM - [R PAK JAE P		
[标]发明人	RASSMAN WILLIAM R PAK JAE P		
发明人	RASSMAN, WILLIAM R. PAK, JAE P.		
IPC分类号	A61B17/50		
CPC分类号	A61B17/32053 A61B17/32093 A61B18/02 A61B19/2203 A61B2019/5206 A61B19/5225 A61B19/5244 A61B2017/00752 A61B2017/306 A61B19/5212 A61B34/20 A61B34/30 A61B90/361 A61B90/37 A61B2090/306		
外部链接	Espacenet USPTO		

摘要(译)

用于毛发移植手术的毛发的采集采用具有成像系统的空心钻，该成像系统允许中空管的切割边缘的中心与毛囊单元的轴线对准以被移除。选择中空管的直径，使得当适当对准时，移除毛囊单元而不损坏毛囊的关键解剖部分。在一个实施方案中，引入液体或蒸气形式的介质以冷却或冻结所选毛囊单位表面上的皮肤。在另一个实施方案中，施加抽吸以帮助切除切除的毛囊单位。在又一个实施例中，采用机械臂在每种情况下定位中空针。在另一个实施例中，施加电流或热量以杀死所选择的毛囊单元的轴而不将其移除。