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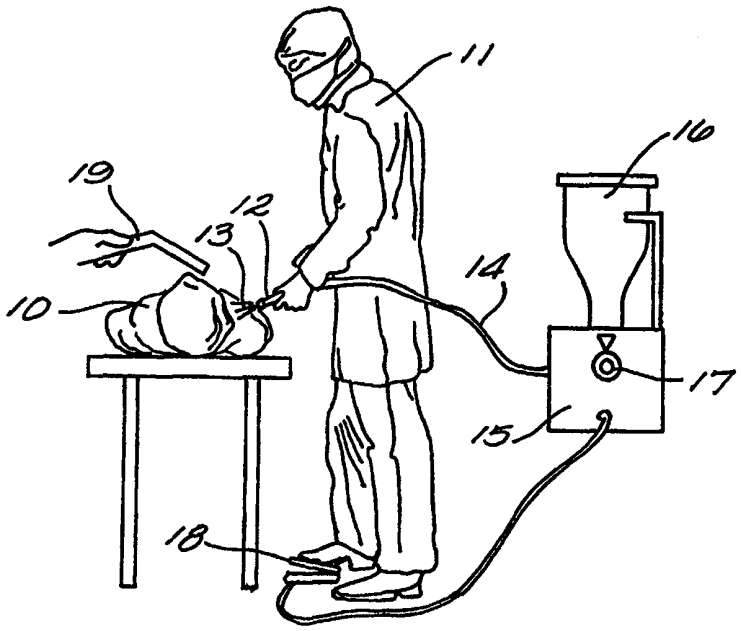

(57) Abstract

This invention is a system for the removal of epidermal and dermal skin through the use of a pressurized stream of water. The surgeon (11) chooses the pressure of the water (12) to obtain the desired abrasive effect. In one embodiment, a variety of medications are added to the water e.g. anesthetics to deaden the skin being abraded; coagulants to minimize bleeding in the abraded area (13); and antiseptics to combat infection after treatment is applied. In one embodiment of the invention, a catch reservoir (56) is positioned around the site being treated to collect to withdraw the spent liquid and remove cells.

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EPIDERMAL AND DERMAL SKIN REMOVAL APPARATUS

Background of the Invention:

This invention relates generally to cosmetic surgery and more particularly to drilling operations of the skin.

Within cosmetic surgery, dermatological treatments remain one of the largest problems. The current modalities available for skin resurfacing include chemical peeling, dermabrasion, and laser resurfacing.

Chemical peeling involves the application of a variety of chemicals to the skin with the intent of producing a chemical burn of a predictable depth. Depending on the agent applied, the skin responds as a chemical burn. Necrotic tissue peels off and is scavenged by macrophages eventually leading to a healing wound. Depending on the depth of the wound new collagen fibers are produced resulting in a thicker more elastic (youthful) appearing skin. At the same time, surface irregularities such as pigmentation problems or textural problems are removed by the peeling and new smoother skin of a more even color replaces it.

Dermabrasion involves removing layers of skin through an abrasive process. Either a diamond fraise or a wire brush is attached to a motor driven rotating device which allows the operator to "sand" down the skin to a given depth. This is different than chemical peeling in that an abrasive wound begins to heal immediately after the injury. There is no delay in wound healing for tissue to peel off or for macrophages to clean up necrotic cells. Abraded wounds depending on the depth also result in improved texture and skin color as well as the deposition of new collagen fibers for thicker more youthful skin. Motorized dermabrasion has also been used for almost a century for smoothing facial scars.

Laser resurfacing is the newest skin resurfacing modality. Currently, ultra pulsed lasers are used to vaporize skin. This extremely precise process burns away tissue to a specific depth. Thermal damage to the remaining tissue is kept at a minimum because the laser pulses at an extremely rapid rate but some

necrotic tissue is left behind which must be scavenged by macrophage before wound healing can ensue. Laser resurfacing also results in more even color and texture to skin as well as the deposition of new collagen fibers.

The three current modalities for skin resurfacing are able to be used interchangeably. Each has its own specific advantages according to the pathology involved and the location of the skin being treated.

None of these modalities provides the ideal method of skin resurfacing. Dermabrasion comes most close to the ideal in that wound healing is able to begin immediately after the surgery. Thus the potential for infection from bacteria and viruses is reduced over chemical peeling and especially laser resurfacing. However, dermabrasion results in brisk bleeding during surgery. This has been suggested to present a danger to both the surgeon and assistants. In aerolized form, the bleeding can also contaminate other individuals in the vicinity of the ventilation system. Also patients are unhappy with the appearance of abrasive wounds and are naturally fearful of bleeding surgical sites.

It is clear from the foregoing that there is a need for an efficient and safe mechanism for the treatment of dermatological conditions.

Summary of the Invention:

The present invention creates a medical or surgical drill in which a high pressure jet of water or other medically acceptable liquid is injected into the patient's skin to create a hole. The drill itself is a probe which is preferably held by the surgeon during the treatment.

Water, benign liquids, or medicinally treated water is provided under high pressure to the probe. When drilling is sought, a burst of the high pressure liquid is directed against a single location on the patient. The burst causes a hole to be created in the patient's skin.

Since only a burst is provided, a drilling, as opposed to a cutting, effect is obtained. The drilling of holes is useful for a variety of medical treatments, including, but not limited to, hair implantation.

In one embodiment, the probe's or applicator's tip is removable allowing the characteristics of the tip to be easily changed by the surgeon for the particular requirements of the procedure. By varying the tip, the size and shape of the hole created is controlled. In the application described above, a small hole size is required for hair implantation, while a much larger hole size is used for body piercing.

In some embodiments, multiple holes in the tip are utilized. These tips permit the surgeon to place the tip and create many holes which are then all useable for the procedure. For example, in one embodiment, four orifices are provided in the tip. The resulting four holes permit the surgeon to implant four separate hair grafts.

Besides round orifices, some embodiments of the opening in the tip have an irregular shape (i.e. star shaped or oval). This allows the surgeon to create, in a single step, a pre-defined shape such as a star.

Activation of the drill is through a variety of techniques including a valve which is activated when the probe's tip is pressed against the skin of the patient. In this embodiment, as the tip is pressed against the skin, the valve is opened allowing

the drilling to be accomplished.

In other embodiments, a finger activated valve allows the surgeon to selectively create the blast of water to drill the site. In alternative embodiments, the valve is activated by a foot pedal.

In other embodiments, the probe's tip is maintained a distance from the patient's skin through the use of a gauge. This type of arrangement assures that the tip is kept a preselected distance from the site.

When a gauge is utilized, the preferred valve is one in which pressure on the gauge itself activates the valve in the probe. The surgeon is then able to "bounce" the probe/gauge from site to site and create the desired drilling affect.

Ideally, medicines are added to the water-jet to create a methodology for applying medicines sub-dermally. The medicines are applied either to the water within the reservoir or are added as the blast is created.

This application is particularly useful where an anti-bacterial medicine is to be applied over a large area beneath the skin. The surgeon simply creates a series of holes using the water/medicine spray allowing the water/medicine to penetrate beneath the skin during the spraying operation.

In the case of a burn victim, the power of the spray is significantly reduced to minimize trauma, and very fine holes are used to implant a local anesthetic and for anti-bacterial solution.

Further, some embodiments of the invention, which are not adapted for the drilling procedure, are utilized for the removal of epidermal and dermal skin through the use of a pressurized stream of water. Water, or another stream of liquid, is directed against the skin layer to abrade the surface cells of the epidermis.

The abrasion process involves repeatedly passing the stream of pressurized water against a site to selectively remove successive cell layers until the proper effect is obtained.

In this task, the surgeon chooses the pressure of the water

to obtain the desired abrasive affect. The key is to obtain the desired water pressure that removes the layer without cutting the skin too deeply.

The pressure chosen must also be tempered with the width of the water spray being used. A wider diameter spray, even at a high pressure is less likely to cut than a thinner spray. In the preferred embodiment, the tip of the probe is equipped with replaceable nozzles which direct the spray in varying bands and which can be adjusted by the surgeon to have a particular orientation (from horizontal to a vertical orientation).

In this context, a water jet dissector is modifiable for skin abrasion.

In another embodiment of the invention, a benign abrasive is added to the water to assist in the removal of the surface cells of the skin. This abrasive is chosen so that any fragments which may remain embedded in the skin after the treatment, do not have any adverse affects upon the patient and are naturally removed by the patient's own immune system.

Some such abrasive include rock salt, ice, and hardened starch. Often such abrasives react with water and are softened by prolonged exposure to the water. In this case, the abrasive is applied to the water as proximate in time to use of the abrasive as possible to keep the abrasive from losing its ability to abrade the skin.

In other embodiments, a variety of medications are added to the water such as: anesthetics to anesthesize the skin being abraded; coagulants to minimize bleeding in the abraded area; and antiseptics to combat infection after treatment has been applied.

Those of ordinary skill in the art readily recognize a variety of medications which serve the above functions and other medications which can be used in this context.

Note that the medications are forced into the epidermis due to the water pressure applied during application and as such form a layer of medicated skin after the surgical procedure has been completed.

While in most applications the waste water and debris the

procedure generates are removed using a catch reservoir positioned around the site being treated. The catch basin collects and withdraws the spent liquid and removed cells.

The preferred catch reservoir is a generally circular shaped mechanism which is place around the surgical site and is then connected to a vacuum pump. The vacuum pump draws air through a channel within the catch reservoir with strategically placed portals so that the waste water and debris is pulled away from the surgical site for appropriate disposal.

This attribute assists in keeping the surgical site clear of water so that the pressurized spray from the surgeon has optimal effectiveness and also assures a clear site for viewing by the surgeon.

In the preferred embodiment, the apparatus is a water driven device with various sized skin probes. The probe both delivers water at high speeds and at the same time suctions away debris and contaminated water. In this manner, the device removes the epidermis and upper dermis. The depth of skin removal is controlled by the rate of water delivery.

Through the use of various sized probes, local skin removal or large areas of skin removal is easily and effectively accomplished.

Water resurfacing is highly advantageous since a clean wound is created while at the same time avoiding the potential for blood splatter and contamination is significantly reduced. The clean wound created by the water resurfacing is much less prone to bacterial and viral infections and more rapidly heals than any of the other resurfacing modalities.

While there are a variety of embodiments envisioned for this invention, in the preferred embodiment, high pressure water is generated by mixing air with a stream of water and/or by introducing a vacuum to a stream of water. This causes "particlization" of the water stream.

The high pressure water is directed through a small orifice usually made through a diamond or sapphire housed in a hand piece. The emitted high pressure stream of water from the hand piece is

directed toward tissue. Control of the high pressure stream is done either free hand or by using a robotic device or a scanner to create more precise patterns of tissue exposure.

The depth of skin penetration is modulated by changing the pounds per square inch of water pressure, the distance of the hand piece from tissue, and/ or the size of the orifice/hand piece.

One embodiment of the invention is intended to assist in the practice of hair transplantation. In this use the high pressure water is used to drill holes through the skin to the layer of the subcutaneous tissue. Small grafts of hair follicles and skin harvested from a donor site in the occipital scalp are then placed into these holes. The theory of donor dominance states that a tissue graft retains all of its original characteristics. Thus hair harvested from the portion of the scalp not influenced by genetic and hormonal factors causing male pattern hair loss retains all of its characteristics when transplanting to balding areas. Thus the hair grows and survives as it would have in its original location i.e. throughout life.

The advantage of using water drilling of recipient holes for hair transplantation is that recipient scalp tissue can be removed as with punching and laser drilling without the need for a secondary step of extracting tissue manually and without the potential thermal effects of laser.

High PSI (3-5000 PSI) water streams cause erosion of skin and allow drilling through the dermis. In this use, the hand piece is manufactured to produce a stream for drilling the approximate size hole or slit (usually in the range of 1x1 to 1x2mm).

A more efficient use of water drilling utilizes a stencil with pre-defined perforated holes located at approximate distances from each other to allow the ideal placement of recipient holes in the scalp. The stencil is placed over the bald scalp and water drilling is applied over the scalp replicating the perforated pattern of the stencil on the scalp. The water drilling can be employed either manually or robotically to expedite the drilling.

Water jets of this invention are also ideally used for preparation of the donor tissue. This tissue is usually harvested

in a long strip from the occipital scalp. The strip is removed either by excising with the water jet discussed above or with a scalpel blade. The donor site is then sutured close.

The harvested strip of hair bearing scalp is then sectioned into small individual grafts usually between 1x1mm and 1x2mm. These grafts are easily sectioned using the water jet by placing the small strips of tissue in an elongated metal housing with linear perforations 1mm apart. The housing holds the strip of tissue securely. The water jet is then applied either manually or robotically to the housing sectioning of the strip into 1 cm segments.

These small segments of hair bearing skin are then manually inserted into the previously drilled recipient site.

In this manner, the water jet of this invention provides a higher level of precision than has been available before since exactly 1mm wide segments of hair bearing scalp are provided.

Should the use of robotic devices be made, this process is made much more efficient and hundreds of grafts are easily sectioned using the water jet technology.

The invention, together with various embodiments thereof, will explained in more detail by the accompanying drawings and following description.

Drawings in Brief:

Figure 1 is a side view of an embodiment of the invention being used by a surgeon.

Figure 2 is a side view of an embodiment of the probe used for the water abrasion of epidermal cells.

Figure 3 is a side view of the pump illustrated in figure 1 showing the plumbing and electrical connections.

Figures 4A and 4B are side and top views of the preferred catch basin.

Figures 5A and 5B are side and top views of the preferred embodiment of the probe.

Figure 6 is a side view of the preferred pump mechanism.

Figure 7 is a side view of a mechanism used to deliver pressurized water.

Figure 8 is a functional layout of the preferred embodiment of the surgical/medical drill.

Figures 9A and 9B are side and cutaway views of an embodiment of the surgical/medical drill in which pressure applied to the tip of the drill activate the drill.

Figure 10A is a side view of an embodiment of the surgical drill in which the tip is removable from the drill body.

Figures 10B, 10C, and 10D are end views of alternative tips for the surgical drill illustrated in figure 10A.

Figure 11 is a side view of an embodiment of the invention which utilizes a surgeon adjusted gauge to maintain the drill a prescribed distance from the patient.

Figure 12A is a side view of an embodiment of the surgical drill in which a suction ring is provided as a guide member.

Figures 12B and 12C are close-up views of the suction member /surgical drill and an end view of the same mechanism.

Figure 13 is a functional layout of a dosage embodiment for the surgical drill.

Figure 14 is a perspective view of an embodiment of the invention using a template for the creation of holes for hair transplantation.

Drawings in Detail:

Figure 1 is a side view of an embodiment of the invention being used by a surgeon.

Surgeon 11 directs probe 12 to the area for the abrasion of epidermal cells on patient 10. A stream of pressurized water 13 is emitted from probe 12 to impact the site. Successive movement across the site dislodges successive layers of epidermal and dermal cells. In this embodiment, suction tube 19 is manipulated to withdraw spent water and debris from the site.

Pressurized water is provided to probe 12 via hose 14 which is connected to pump 15. Water is withdrawn from reservoir 16 for use in this process. The level of pressurization of stream 13 is established via control knob 17.

When surgeon 11 depresses foot switch 18, water is directed from pump 15 to probe 13 for use thereby.

As noted before, within this context sterile water is the preferred liquid although other suitable liquids are also obvious to those of ordinary skill in the art including alcohol or a combination of alcohol and water.

Figure 2 is a side view of an embodiment of the probe used for the water abrasion of epidermal cells.

Probe 12, first illustrate Through proper selection of nozzle 20, characteristics of spray 13 are readily alterable to accomplish the task chosen by the surgeon.

Probe 12 is connected to hose 14 via male connector 21 which slips into and is secured to slide connector 22. In this manner, a variety of probes are easily interchanged and connected to hose 14 for selected uses by the surgeon.

Figure 3 is a side view of the pump illustrated in figure 1 showing the plumbing and electrical connections.

As noted with relation to figure 1, reservoir 16 holds the sterile water which is to be used in this application. Water from reservoir 16 is communicated by pipe 36B to pump 32 which provides a cter from pump 32 is discharged into pipe 36C.

When water is not being used in the abrading function, valve 31A is open and valve 31B is closed; hence, the pressurized water

within pipe 36C is communicated via pipe 36A back into reservoir 16.

When water is being used for abrasion, valve 31B is open and valve 31A is closed; pressurized water is then passed from pipe 36C through valve 31B into pipe 36D for communication through connector 33 to hose 14 which communicates with the probe (not shown in this illustration).

Electrical energy is used to control valves 31A and 31B. Electrical energy is obtained via plug, electrical energy is directed to flow to pump 32 via wire 37B and to foot switch 18 via wire 37A.

The foot switch, when activated, communicates the electrical energy back to valves 31A and 31B via wire 37C. In a passive condition, valve 31A is open and valve 31B is closed. When electrical energy is applied, valves 31A and 31B change to the opposing state (closed and open respectively).

In this manner, a selected water pressure level is obtained and maintained for the surgeon's use.

Figures 4A and 4B are side and top views of the preferred catch basin.

Referring to both figures 4A and 4B, in this embodiment catch basin 40 is generally circular in shape and is secured to skin 46 of patient via adhesive 45. Since catch basin 40 is open in the center, probe 12 is able to direct pressurized water 13 via nozzle 20 against the epidermis at the surgical site.

An internal channel 42 extends around the circumference of catch basin 40. The internal channel 42 communicates with the interior portion via portal channels 42 which exit proximate to the base of the catch basin. Tube 44 communicates with internal channel 42 and a suction pump (not shown).

The suction pump creates a partial vacuum which draws spent water 43 and debris through channels 42, into internal channel 42 to finally be discarded. In this manner, the surgical site is kept free of spent water and debris providing the surgeon a clear view of the site.

Figures 5A s thumb rest 52. Pressure adjustment switch 59A

is positioned to be controlled by the surgeon's fore-finger. In similar manner, on/off switch 59B is also positioned to be activated by the surgeon's fore-finger.

As discussed before, pressurized water is communicated to the probe via hose 51A. The pressurized water is communicated via an internal channel within the probe to exit via nozzle 55.

In this embodiment, shield 53 is secured to probe 50 via screws 57A and 57B which allow rotational adjustment of shield 53 as shown by arrows 58A and 58B. This rotation of shield 53 provides a depth control guide. In application, the base of shield 53 is pulled or pushed along the skin; shield 53 maintains nozzle 55 at the chosen distance from the skin. By maintaining nozzle 55 at a set distance from the skin layer, optimal abrasion without excessive damage is obtained.

Shield 53 is further equipped in this embodiment with a catch tray 56 which collects the spent water 48. This spent water is drawn through holes (not shown) near the catch tray to be drawn through hose 51B and then properly discarded.

To assist with the viewing of the site, this embodiment is equipped with lamp 54. Power for lamp 54, as well as communication channels for pressure adjustment switch 59A and on/off switch 59B, is provided by electrical hook-up 49 which communicates with the pump (not shown).

Figure 6 is a side view of the preferred pump mechanism.

Reservoir 60A is used to contain a benign abrasive; reservoir 60B is used to contain a chosen medicinal component or combination of medicines; and reservoir 60C is used to contain the sterile water.

Water from reservoir 60C is communicated into internal reservoir 61A. In a manner similar to that described in figure 3, pump 65B draws water from internal reservoir 61A and provides pressurized water to valves 62C and 62D which are selectively activated by control circuit 67 to either re-circulate the water to internal reservoir 61A or to be communicated via connector 63A to hose 51A for use by the probe described in figures 5A and 5B.

When pressurized water is communicated to the probe via

connector 63A, valve 62A is opened to let the benign abrasive enter the channel, and valve 62B is opened to permit the medicine to enter the channel to form a composite stream of water/abrasive/medicine to the probe.

Motor 66 is used to drive pump 65B and pump 65A. Pump 65A is used to suction spent water and debris via hose 51B from the surgical site via connector 63B and to deposit the spent water and debris into internal reservoir 61B. After the surgery, the contents of internal reservoir 61B are dumped into drain 70.

Control circuit 67 is used to operate motor 66 and to activate valves 62A, 62B, 62C, and 62D. Power to control circuit 67 is provided from plug 69 which connects through connector box 68 with control circuit 67 as well as with light 54 via electrical connector 64B.

Surgeon adjustment of the control circuit 67 is provided from switches 59A and 59B (described in figures 5A and 5B) and are communicated via connector 64A.

Figure 7 is a side view of a mechanism used to deliver pressurized water.

Pressure container 71 contains both a volume of sterile water 75B and an air volume 75A. An air pressure source is turned off/on by valve 74 which communicates with adjustment valve 72. The pressure level of air volume 75A is controlled by the surgeon through adjustment of handle 7.

Pressure in air volume 75A is transferred to the water volume 75B which is forced through tubing 76 and is communicated to valve 78. As the surgeon depresses foot lever 77, valve 78 is opened letting the sterile water to pass through tubing 79 to probe 12.

In this manner, the surgeon is able to select the desired pressure and then selectively use the pressurized water for the abrading operation.

Figure 8 is a functional layout of the preferred embodiment of the surgical/medical drill.

Probe 80 is held by the surgeon 83A and is directed towards a surgical site on patient 86. Probe 80 is provided a high pressure supply of liquid from reservoir 82 via pump 81.

Activation of probe 80 to create a burst of liquid 87, in this embodiment, is accomplished via the foot 83B w of the surgeon which activates foot switch 85. Activation of foot switch 85 causes valve 88 to open for a very short period of time to allow a single burst 87 to be created.

The impact of burst 87 onto the surgical site of patient 86 causes a hole to be created.

Figures 9A and 9B are side and cutaway views of an embodiment of the surgical/medical drill in which pressure applied to the tip of the drill activate the drill.

Probe or handle 90 is attached to the high pressure source via coupling 91 which communicates with interior bore 93.

In this embodiment, when tip 92A is pressed against the patient (not shown) to move the tip to position 92B, a single burst is created to cause the drilling or boring action.

Within interior bore 93 is imposed valve ball 94 which has an opening 95 extending completely therethrough. As valve ball 94 is rotated from its dormant position, as shown, opening 95 becomes aligned with interior bore 93, allowing the high pressure water to escape therethrough as burst 97.

Valve ball 94 is activated by movement of tip 92A which forces connecting rod 98 to quickly rotate armature 96A through position 98B and then back.

In this way, the embodiment of figure 9A and 9B allow the surgeon to simply "tap" the surgical site to have the drilling operation performed.

Figure 10A is a side view of an embodiment of the surgical drill in which the tip is removable from the drill body.

Handle 100 is secured to the high pressure source via connector 101. At the opposing end of handle 100 is threaded portion 104 which accepts tip 102A. The ability to remove tip 102A permits the surgeon to select the size and shape of the orifice being used and also facilitates in the cleaning and sterilizing of the instrument.

Figures 10B, 10C, and 10D are end views of alternative tips for the surgical drill illustrated in figure 10A.

Each of tips 102A, 102B, and 102C have differing orifices 103A, 103B, and 103C which form different shaped drilling actions. As example, the hole created by orifice 103A (round having a relative large diameter) is totally different from the drilled hole created by orifice 103C ("+" shaped).

Those of ordinary skill in the art readily recognize that the size and shaped of the holes created by this invention are practically limitless and provide the surgeon with heretofore unavailable options; the current art is simply a circular shape (the cross section of a drill).

Figure 11 is a side view of an embodiment of the invention which utilizes a surgeon adjusted gauge to maintain the drill a prescribed distance from the patient.

Handle 110 has gauge 112 secured thereto to maintain tip 114 a set distance from the patient. Gauge 112 is generally circular in shape with a hole therein to permit the burst of water to pass therethrough.

Legs 113 of gauge 112 are secured and adjusted through set screws 111. In this manner, the surgeon is able to adjust the distance between gauge 112 and tip 113.

This particular embodiment is particularly useful for the treatment of acne cysts and other skin lesions as the drilling affect removes the underlying lesion, cleanses, and in the embodiment where the water burst is medicated, also medicates the lesion site.

Another use for this embodiment, is the removal of warts. The drilling effect simply erodes the wart leaving a small hole where the wart used to be. Larger warts are treated by delivering medication into the wart itself.

Figure 12A is a side view of an embodiment of the surgical drill in which a suction ring is provided as a guide member.

Figures 12B and 12C are close-up views of the suction member /surgical drill and an end view of the same mechanism.

Surgeon 119 grasps the apparatus which includes probe 120 and gauge 125. Through a motion as indicated by arrow 126, bursts of drilling water 128 are generated from orifice 120A which impacts

and "drills" into the patient.

The high pressure water is provided by pump 121 which draws its source from a medicated reservoir 122 which is a combination of water and medicine.

Gauge 125 is a hollow member and is connected to suction pump 124 which draws water and debris as depicted by arrows 129 which are communicated to a waste receptacle.

The surgical site is illuminated by fiber-optics 127 which receive their source illumination from light 123. In this manner, the surgeon is able to easily see the surgical site.

Figure 13 is a functional layout of a dosage embodiment for the surgical drill.

Drug 131 is dropped into the channel and is retained by retaining ring 132. Retaining ring 132 is a flexible membrane which is adapted to "open" under pressure. This pressure is provided when high pressure water 130 is applied; but, the pressure generated by drug 131 alone is insufficient to open retaining ring 132.

Once the high pressure water 130 is provided, retaining ring 132 opens and a mixture 133 of drug and water is injected into the patient in a drill operation.

Figure 14 is a perspective view of an embodiment of the invention using a template for the creation of holes for hair transplantation.

Often, high PSI (3000-5000 PSI) water streams can cause erosion of skin and allow drilling through the dermis. In this use, the hand piece is manufactured to produce a stream for drilling the approximate size hole or slit (usually in the range of 1x1 to 1x2mm).

A more efficient use of water drilling utilizes a stencil 141 with pre-defined perforated holes located at approximate distances from each other to allow the ideal placement of recipient holes in the scalp 142. Stencil 141A is placed over the bald scalp 142 and water drilling 143 is applied over the stencil 141A to replicate the perforated pattern of stencil 141 on the scalp 142.

It is clear that the present invention creates a highly

improved mechanism for a variety of surgical requirements.

What is claimed is:

1. A surgical drill comprising:

a) a reservoir containing a liquid;

b) pumping means connected to said reservoir, for supplying said liquid under high pressure;

c) an applicator adapted to receive said liquid under high pressure, said applicator including a valve adapted to selectively communicate a burst of said liquid under high pressure from a tip thereof against a surgical site, said burst adapted to pierce said surgical site.

2. The surgical drill according to claim 1, wherein said valve is activated by longitudinal pressure applied to the tip of said applicator when pressed against the surgical site.

3. The surgical drill according to claim 2, wherein said tip is removable from said applicator.

4. The surgical drill according to claim 1, further including a gauge connected to said applicator adapted to maintain said tip of said applicator a pre-selected distance from the surgical site.

5. The surgical drill according to claim 4, wherein said gauge is adjustable by a surgeon.

6. The surgical drill according to claim 5, wherein pressure applied to said gauge by a surgeon pressing said gauge against said surgical site activates said valve.

7. The surgical drill according to claim 1, further including means for including a therapeutic drug in said burst of liquid.

8. A medical drill comprising:

a) means for applying a stationary piercing burst of high

pressure water against a surgical site until a chosen depth has been reached by said high pressure water; and,

b) means for evacuating said surgical site of water and bio-debris.

9. The medical drill according to claim 8,

a) further including a removable tip secured to said applicator; and,

10. An apparatus for body contouring comprising:

a) a vacuum mechanism;

b) a water pump adapted to provide a sterile liquid under pressure; and,

c) a probe having,

1) a handle portion adapted to be grasped by a surgeon,

2) a first cannula secured to said handle and having an open distal end adapted to be placed near a surgical site, said first cannula receiving pressurized water from said water pump, and,

3) a second cannula secured to said handle and having an open distal end positioned proximate to the open distal end of said first cannula, said second cannula in communication with said vacuum mechanism.

11. The apparatus according to claim 10,

a) further including an endoscope; and,

b) wherein said probe further includes a bracket for attaching said probe to a distal end of said endoscope.

12. The apparatus according to claim 11, further including operator adjustment means for selectively varying a pressure of said sterile liquid from said water pump.

13. The apparatus according to claim 12, wherein said pressure is insufficient to damage nerves.

14. The apparatus according to claim 13, wherein said sterile liquid includes a vaso-constrictor.

15. A surgical probe comprising:

a) a handle adapted to be grasped by a surgeon;

b) a first cannula secured to said handle and having an open distal end adapted to be placed near a surgical site, said first cannula conducting pressurized water; and,

c) a second cannula secured to said handle and having an open distal end positioned proximate to the open distal end of said first cannula, said second cannula adapted to withdraw liquid and debris from said surgical site.

16. A method for abrading skin from a patient comprising the steps of:

a) identifying a surface area of skin for abrading; and,

b) repeatedly directing a pressurized stream of water sufficient to remove surface cells from said area of skin.

17. The method according to claim 16, further including the step of applying an anesthetic to said stream of water.

18. The method according to claim 17, further including the step of applying a coagulant to said steam of water.

19. An apparatus adapted for the selective abrasion of an epidermis of a patient comprising:

a) a reservoir containing water;

b) a pump connected to said reservoir, said pump generating an operator defined water pressure; and,

c) a handle member having,

1) a nozzle,

2) a light source directed to emit light past said nozzle, and,

3) a valve adapted to direct water from said pump through said nozzle, said valve being selectively engaged by a surgeon.

20. The apparatus according to claim 19, further including:

a) a catch reservoir adapted to be positioned around a chosen site of skin and allowing surgeon access therethrough to said site of skin, said catch reservoir having an internal channel, and a plurality of portals extending from said internal channel, said plurality of portals exposed

proximate to a lower portion of said catch reservoir; and,

b) evacuation means connected to said internal channel for withdrawing liquids entering said plurality of portals.

21. The apparatus according to claim 20, wherein said catch reservoir is adapted to direct liquid to said plurality of portals.

22. The apparatus according to claim 21, further including an adhesive positioned on a first side of said catch reservoir and adapted to secure said catch reservoir to skin of a patient around the site of epidermis.

23. An epidermal and dermal skin removal system adapted for the selective abrasion of an epidermis and dermal of a patient comprising:

a) a source of a sterile liquid conveyed under selected pressure;

b) a handheld nozzle; and,

c) an operator manipulatable valve adapted to direct sterile liquid from said source to said handheld nozzle.

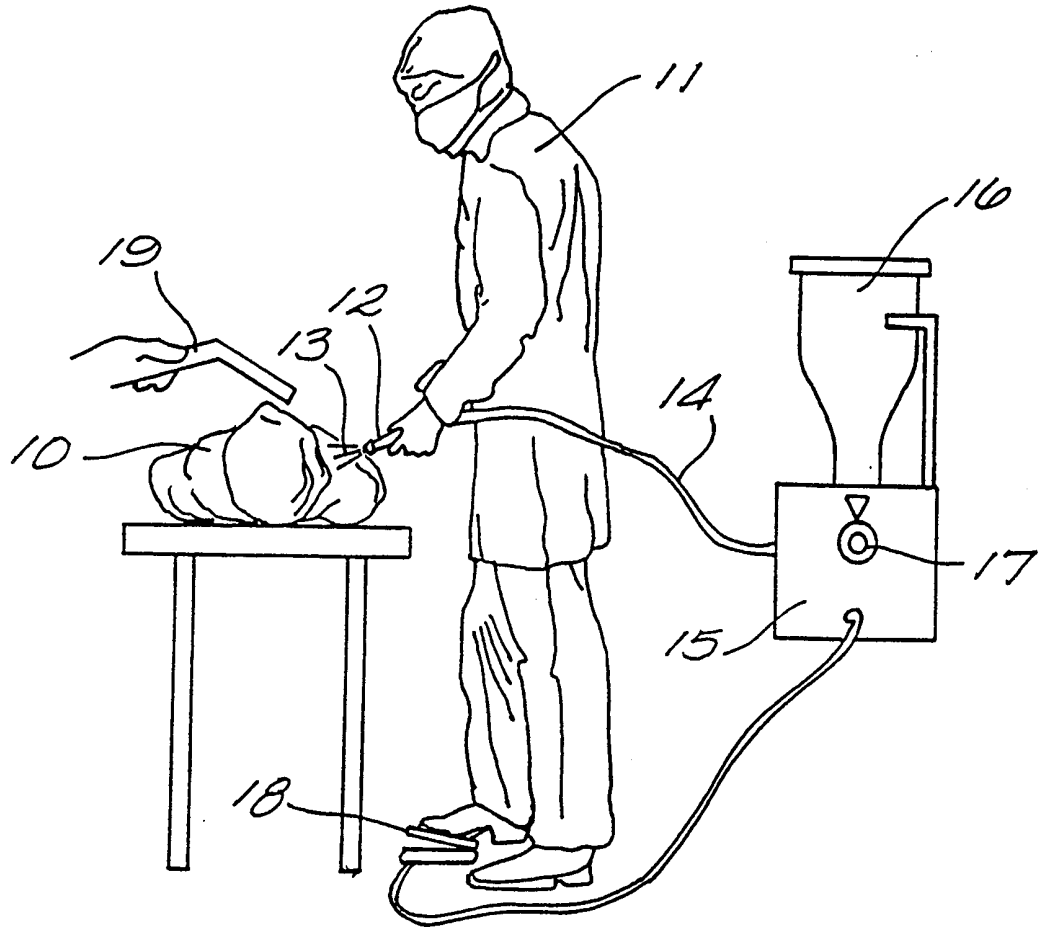


FIG. 1

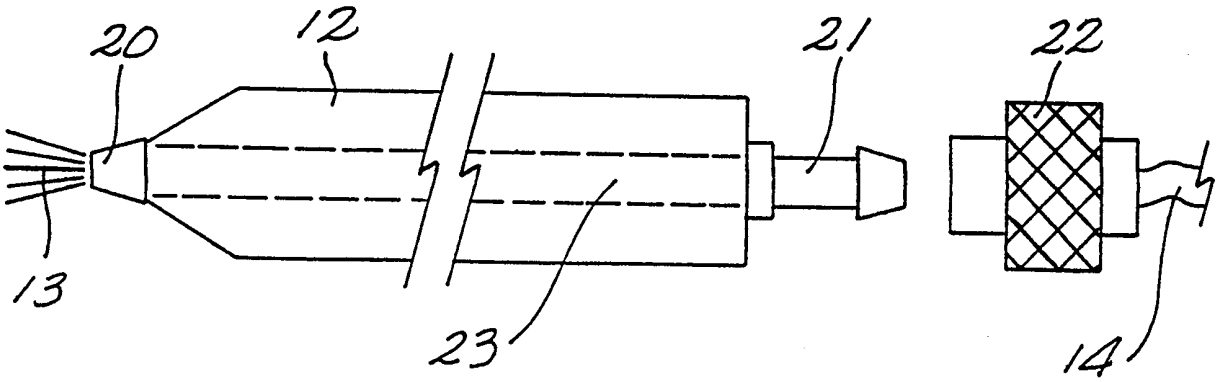
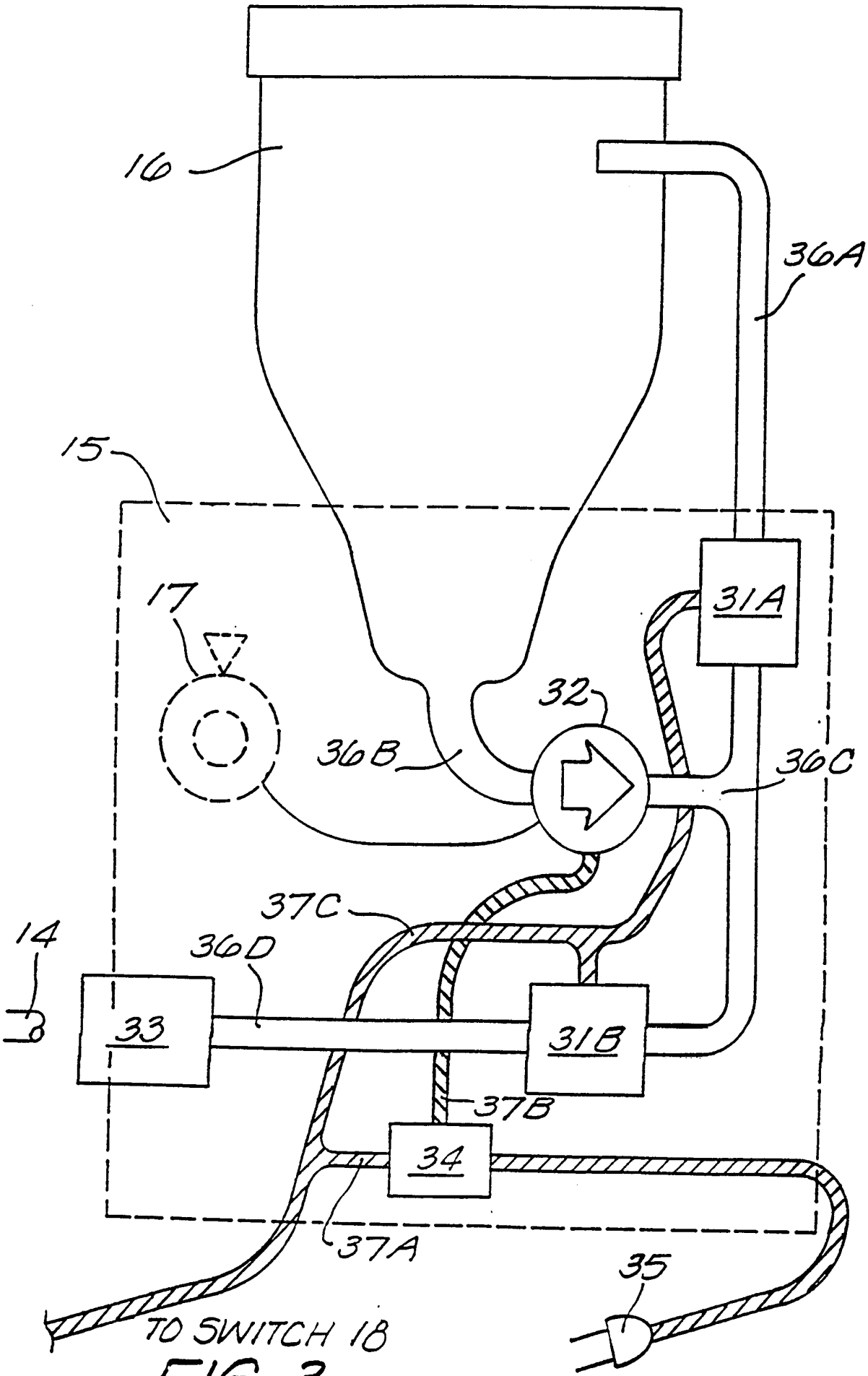


FIG. 2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36A
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17
31A
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36B
36C
37C
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36D
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31B
37B
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37A
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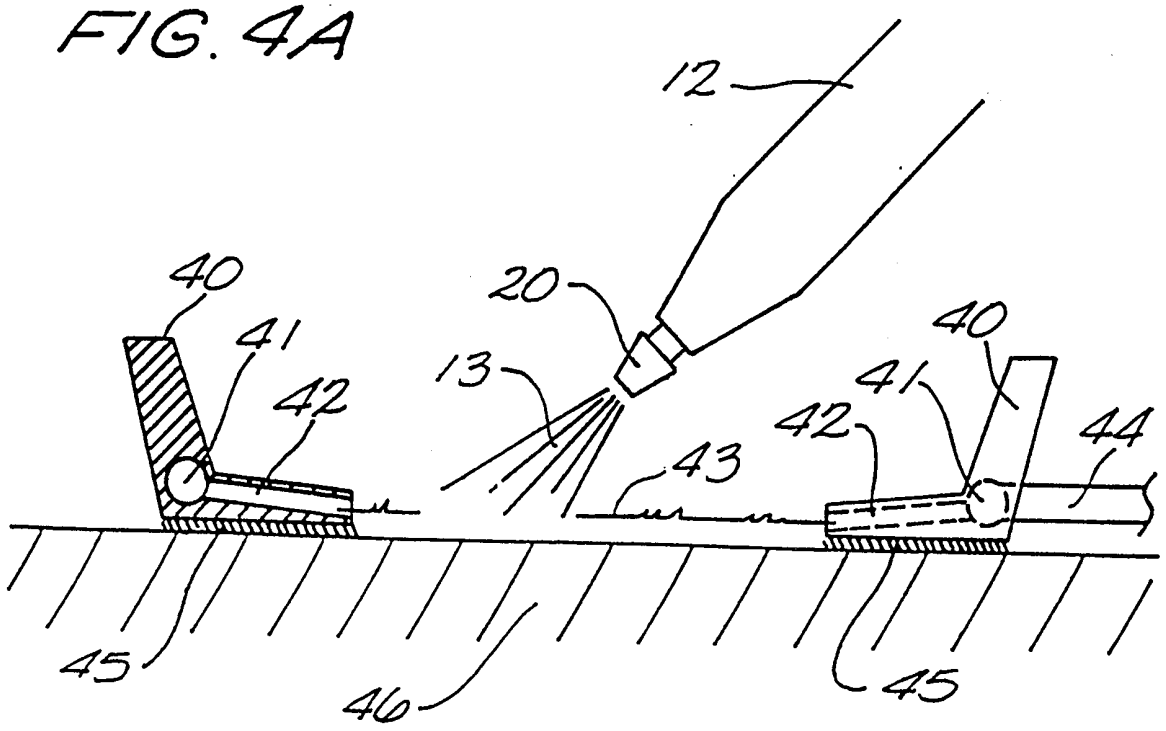
TO SWITCH 18

FIG. 3

FIG. 4A



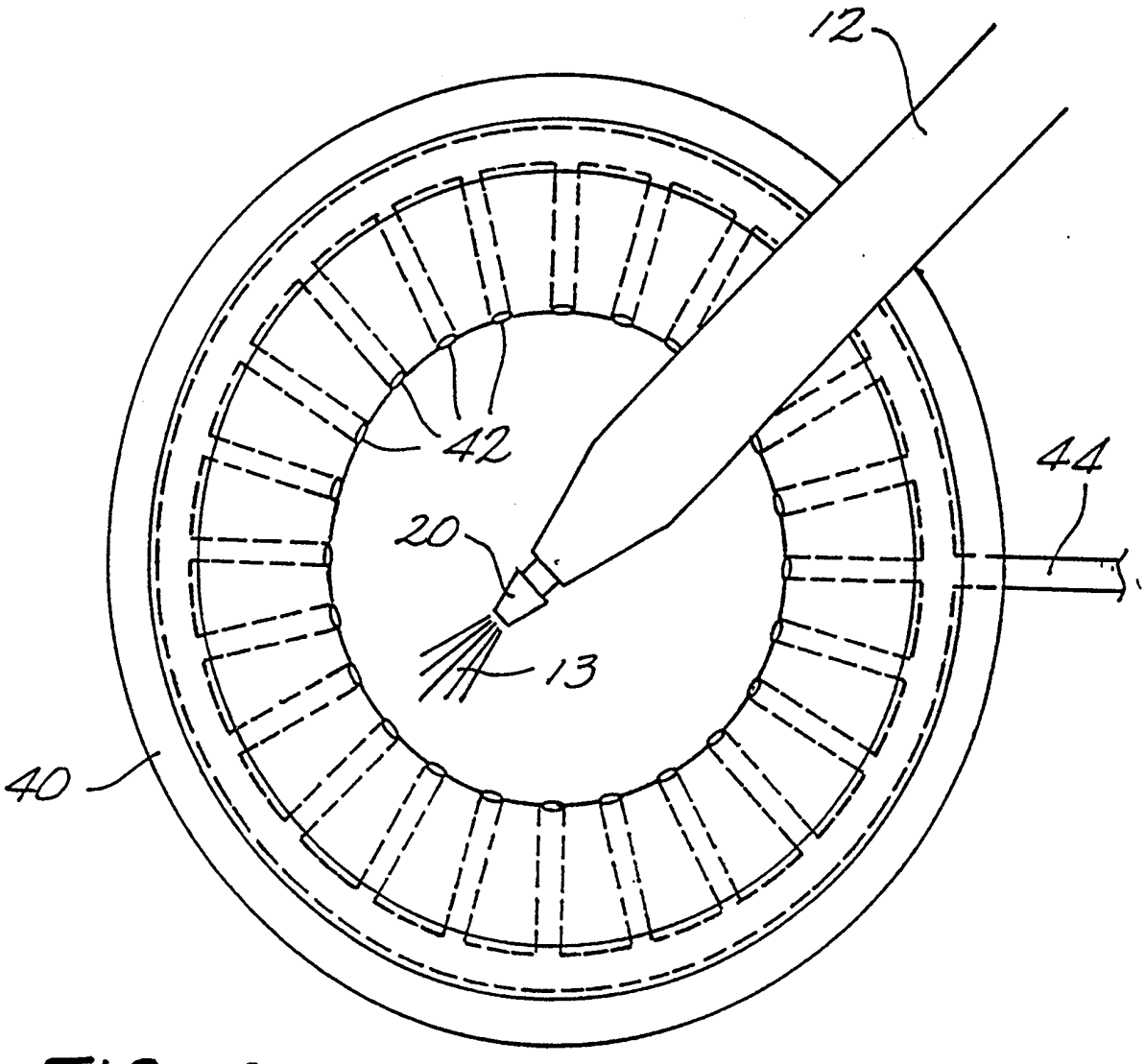
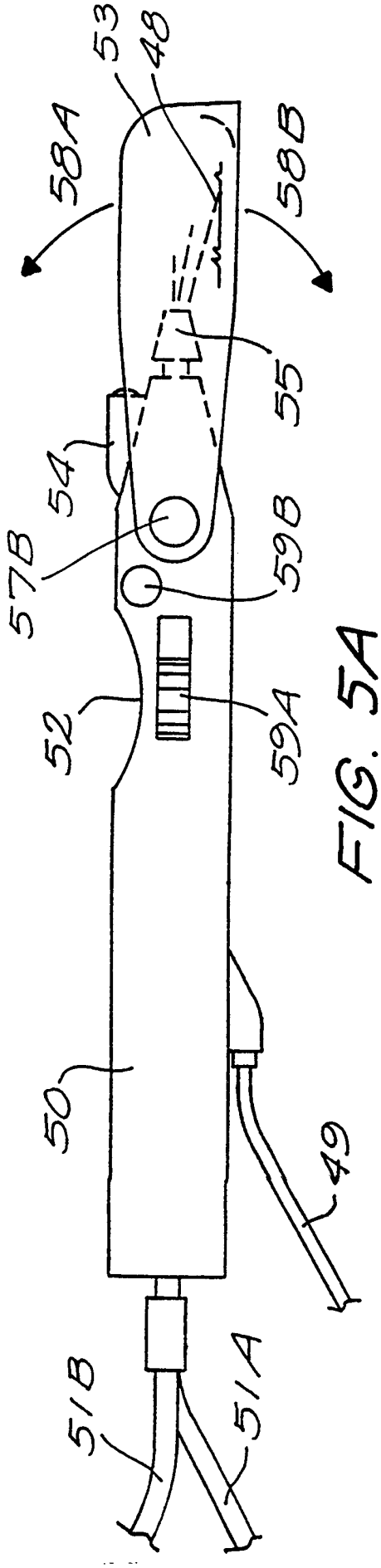


FIG. 4B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58A
58B
55
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57B
59B
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59A
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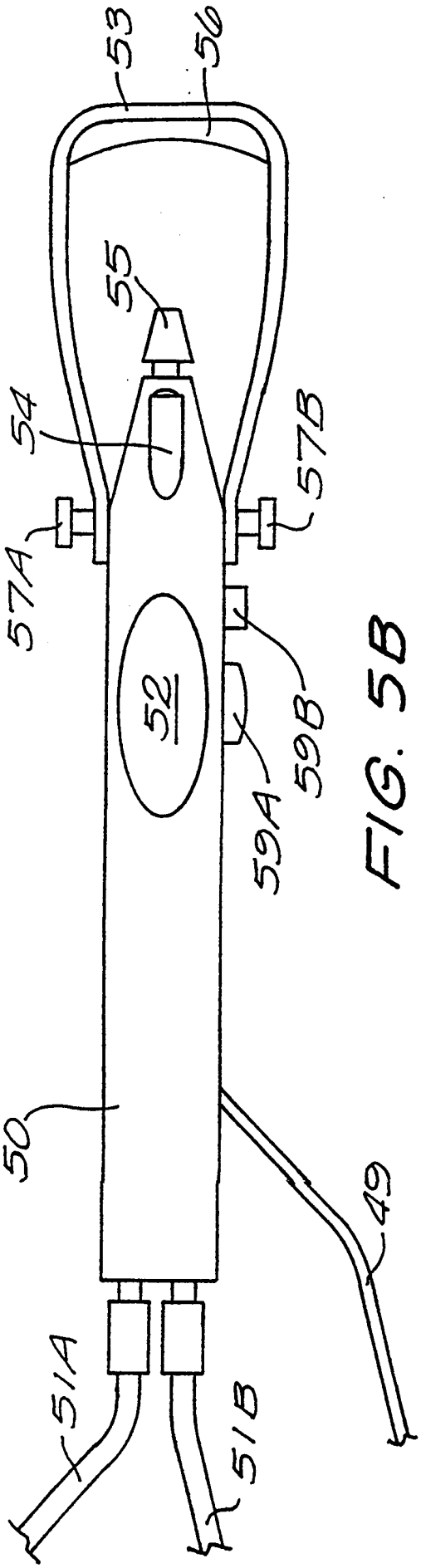
51B
51A

FIG. 5A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57A
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59B
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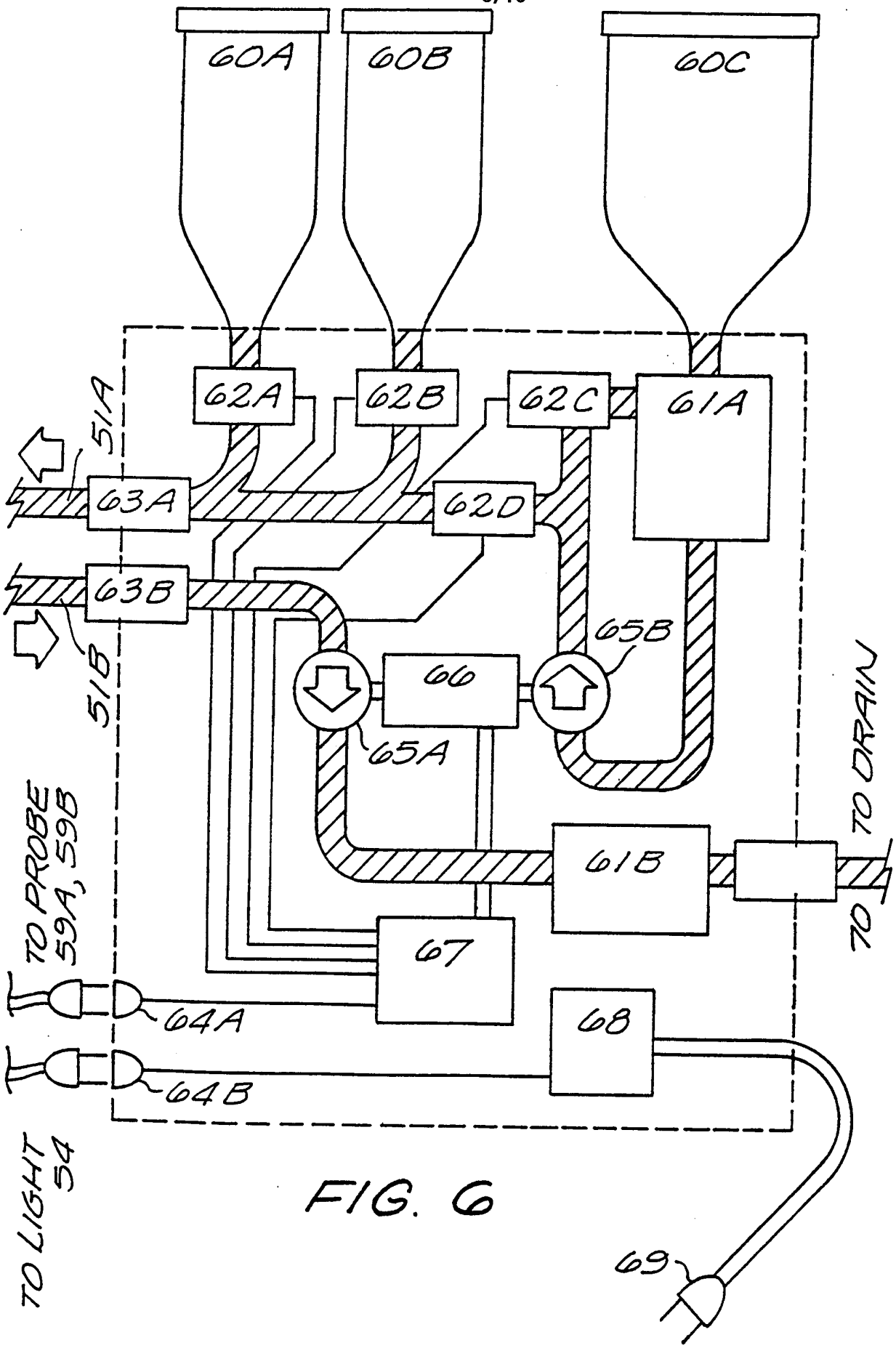
FIG. 5B


60A
60B
60C
62A
62B
62C
61A
51A
63A
62D
63B
51B
65B
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65A
TO DRAIN
TO PROBE 59A, 59B
61B
67
64A
68
64B
TO LIGHT 54
69

FIG. 6

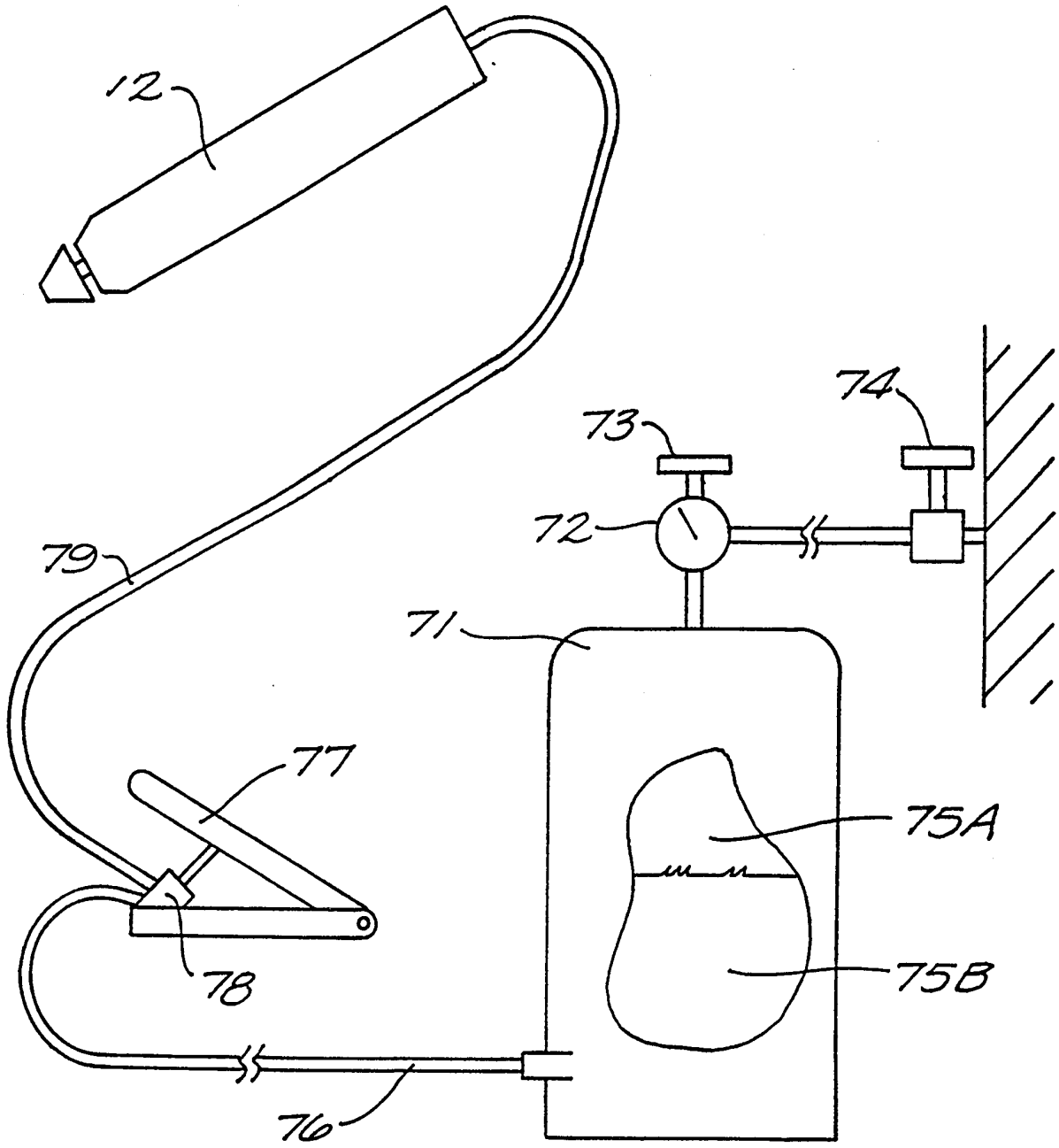

FIG. 7

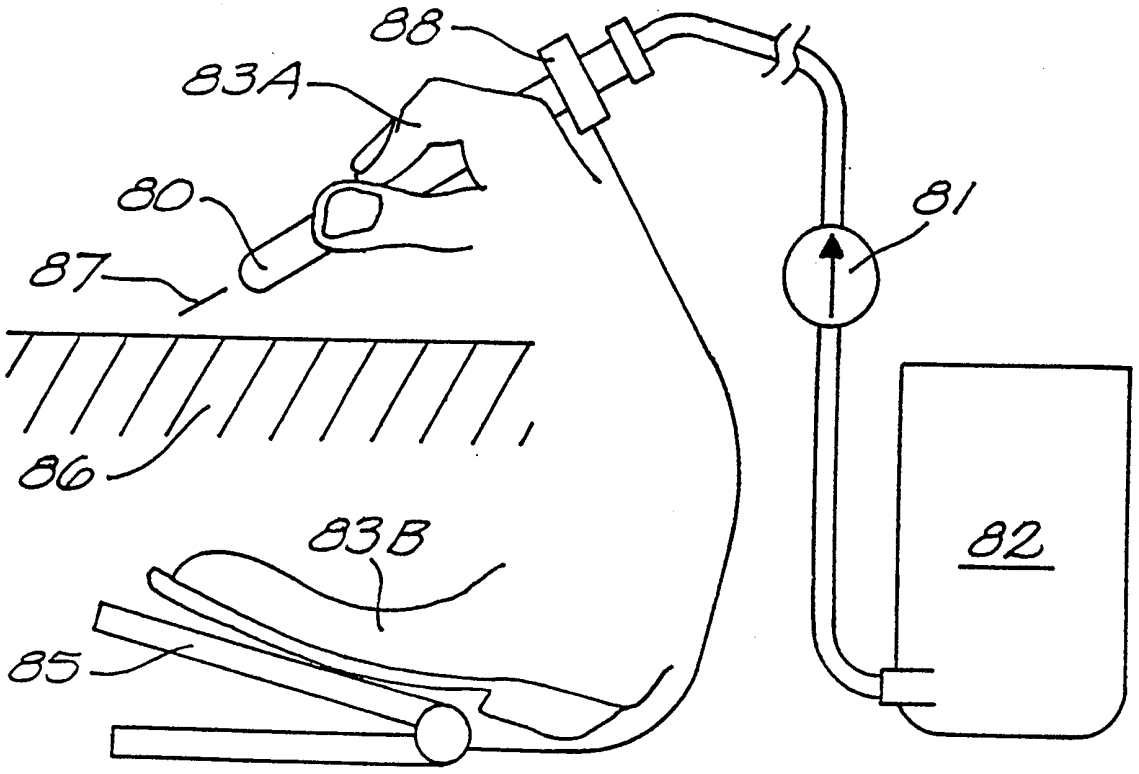

FIG. 8

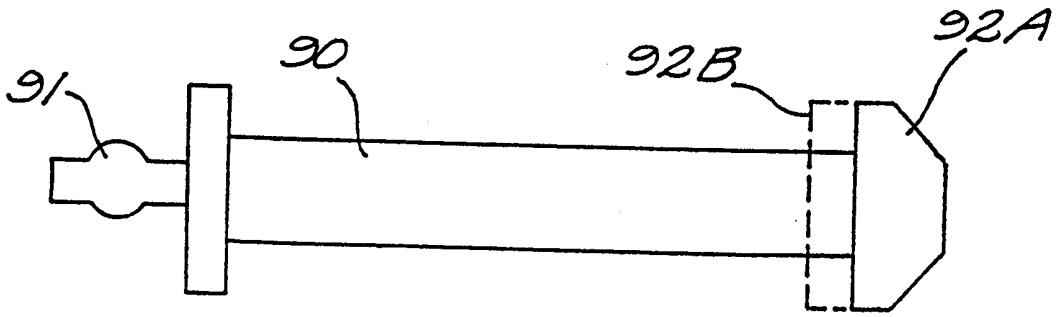

FIG. 9A

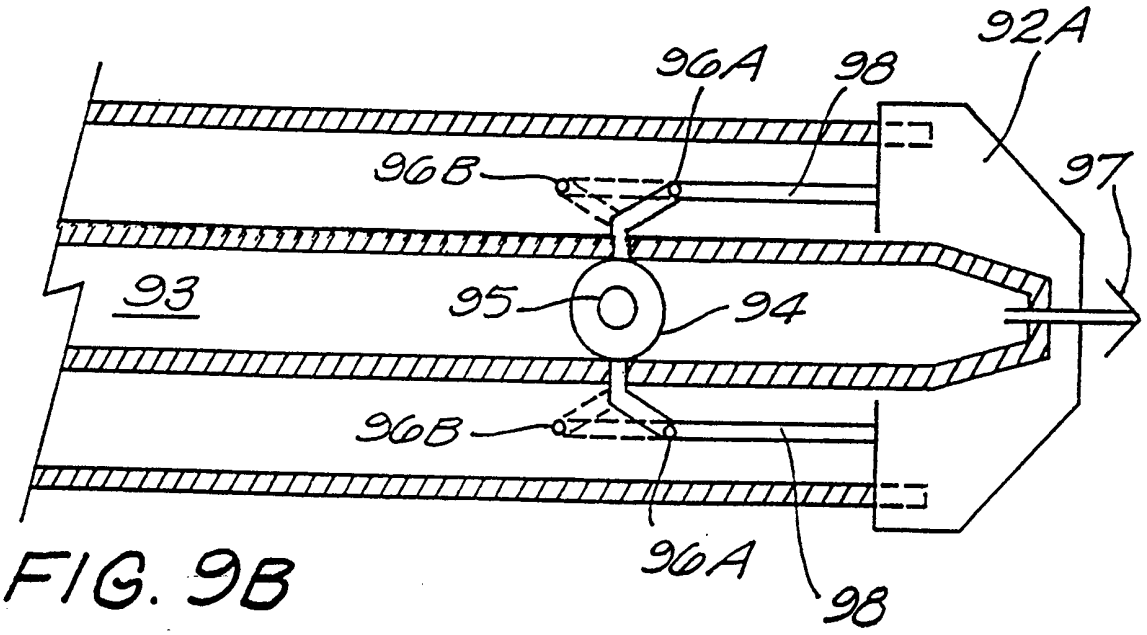

FIG. 9B

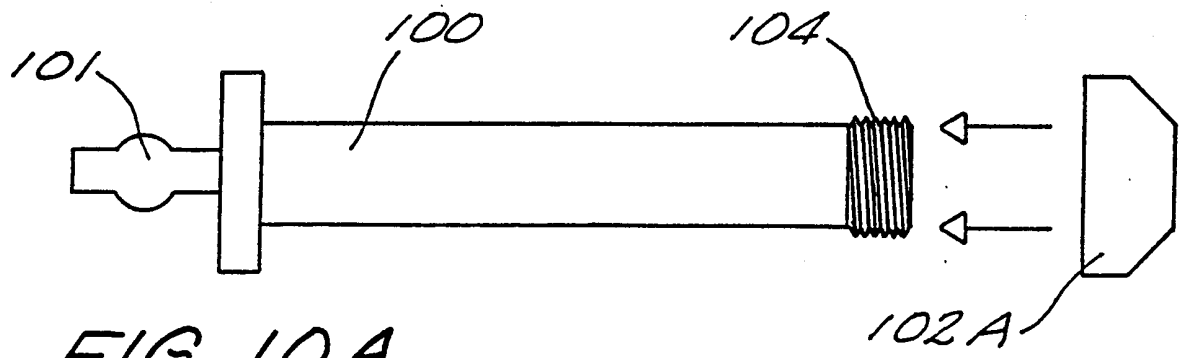

FIG. 10A

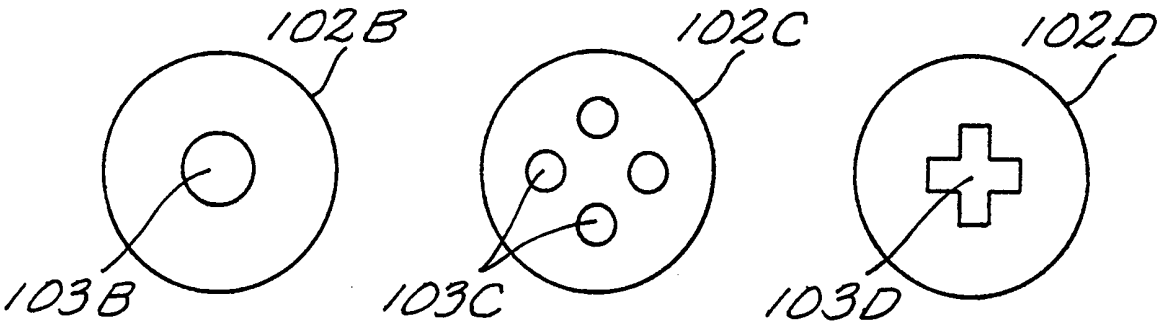

FIG. 10B FIG. 10C FIG. 10D

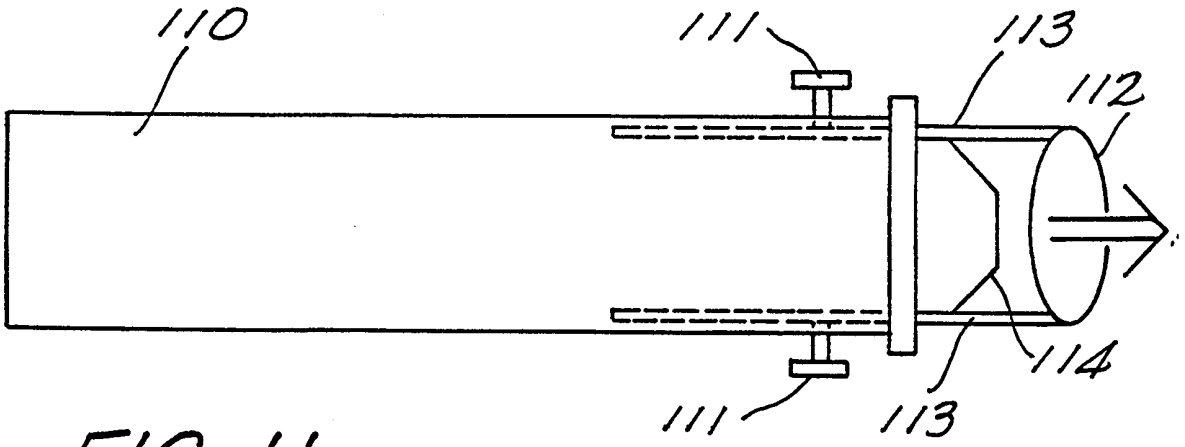

FIG. 11

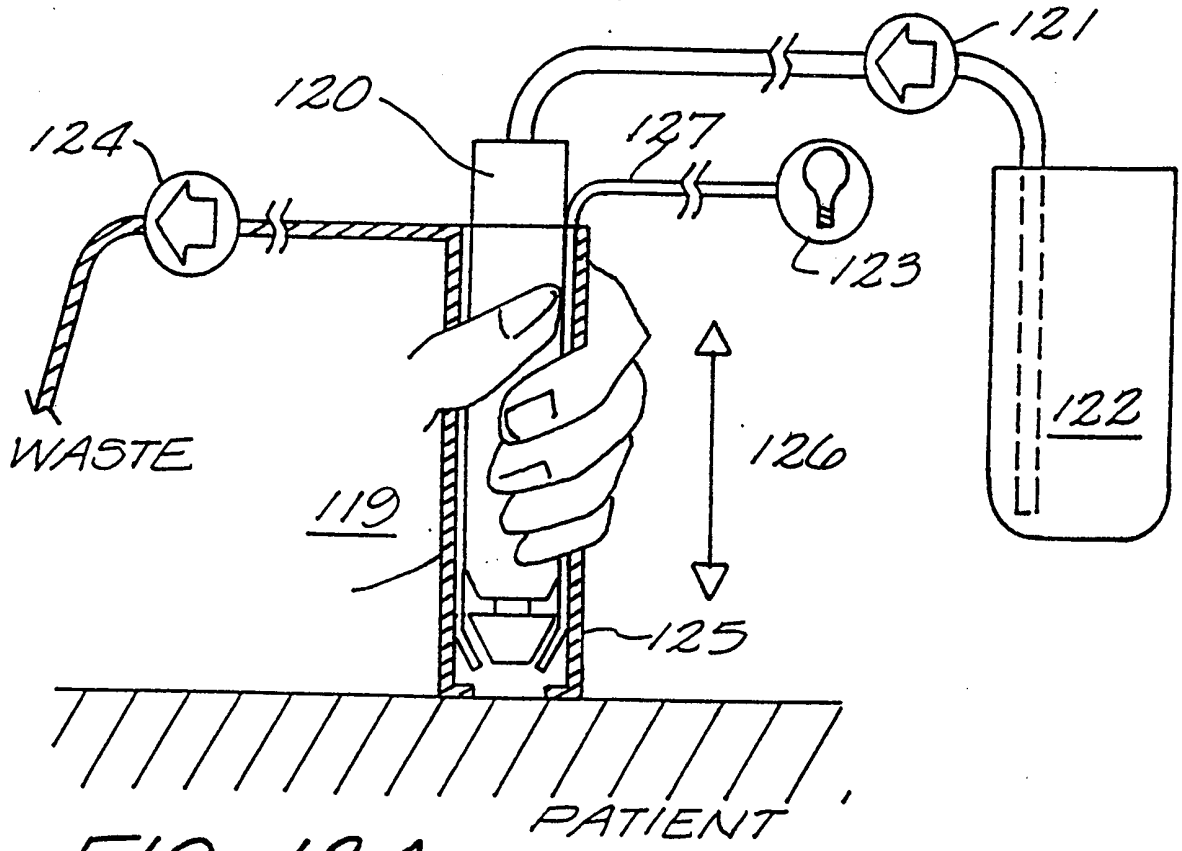

FIG. 12A

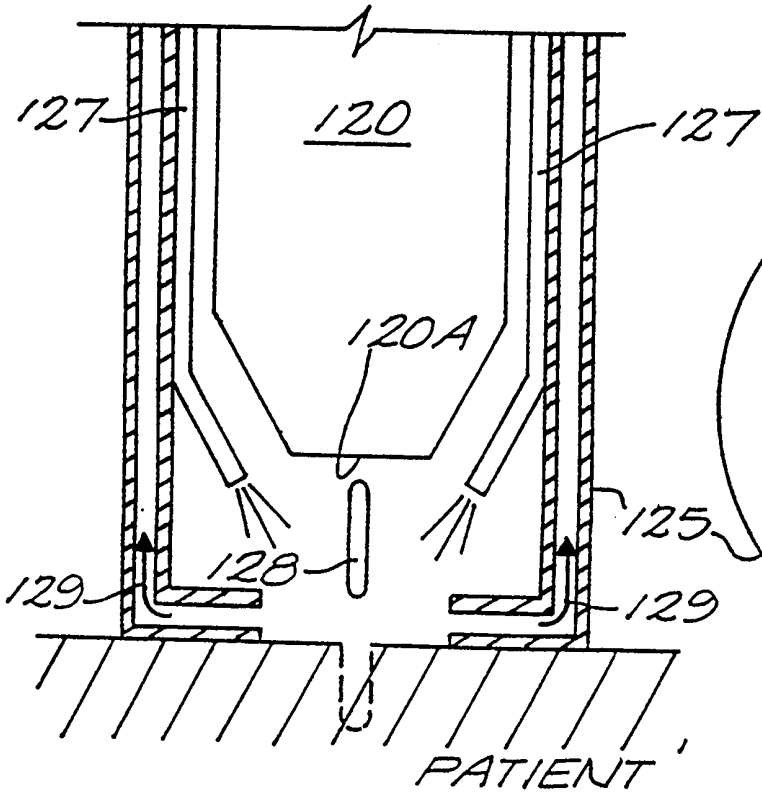

FIG. 12B

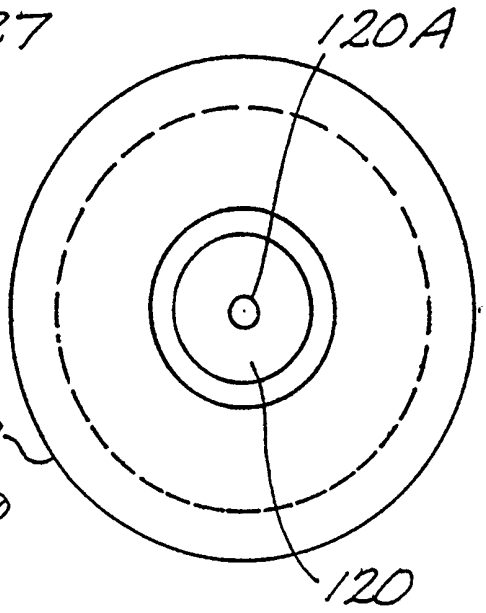

FIG. 12C

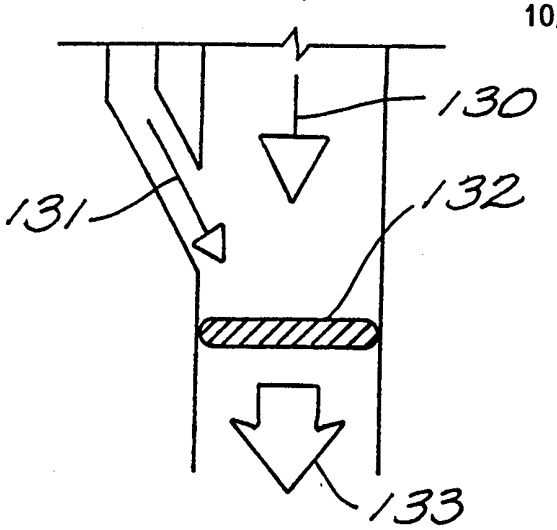

FIG. 13

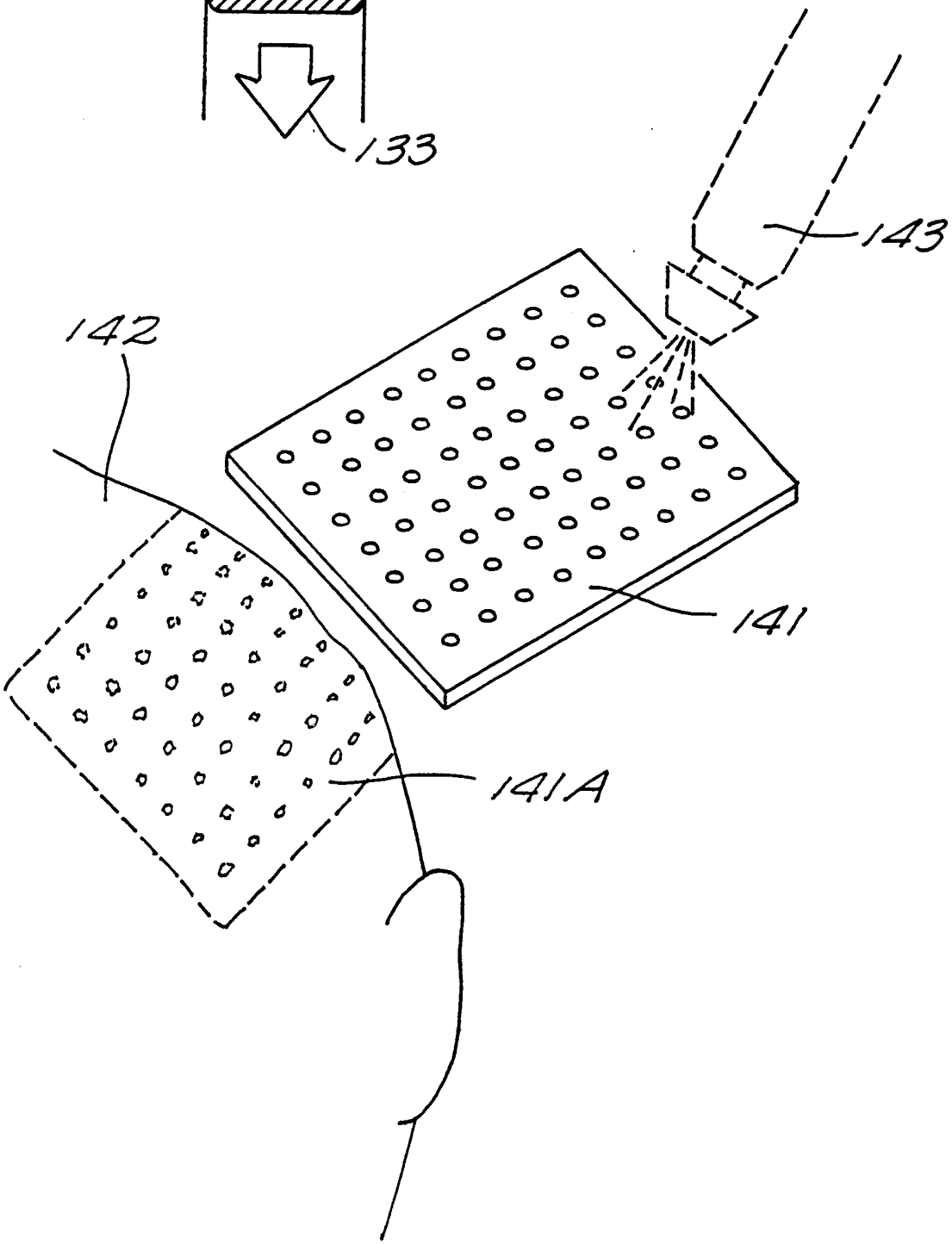

FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/01440

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61B 17/50
US CL :604/289; 606/9, 131

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 606/131, 9; 604/289

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,037,431 A (SUMMERS et al.) 06 August 1991, col. 2 lines 33-68; AND col. 3 lines 1-33.	10-23
X	US 5,037,432 A (MOLINARI) 06 August 1991, col. 2, 3 and 4.	10-23
Y	US 5,012,797 A (LIANG et al.) 07 May 1991, col. 2 lines 20-51.	12, 17
X	US 5,100,412 A (ROSSO) 31 May 1992, col. 2 lines 1-68.	10-23

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 25 FEBRUARY 1999	Date of mailing of the international search report 28 MAY 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 308-2708	Authorized officer (JACKIE) TAN-UYEN THI HO Telephone No. (703) 306-3421

Form PCT/ISA/210 (second sheet)(July 1992)★