A therapeutic apparatus for stimulating the healing of a wound site includes a polyurethane foam positioned at the wound site and a connector having a disc-like cup and an elbow-shaped spout. The connector is positioned in contact with the polyurethane foam, and the elbow-shaped spout is configured for connection to a tube that is capable of delivering negative pressure through the elbow-shaped spout and to the polyurethane foam. The therapeutic apparatus further includes a drape having a hole, the drape being positioned over the connector such that the elbow-shaped spout extends through the hole in the drape.
WOUND TREATMENT APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to the healing of wounds and, more particularly, to apparatus for stimulating the healing of superficial wounds.

[0004] 2. Description of Related Art

[0005] PCT Application No. GB95/01983 (WO 96/05873) describes apparatus for stimulating the healing of wounds comprising a porous pad which is permeable to fluids for introduction into the wound, a dressing for covering the wound and providing an air-tight seal around the wound, a drainage tube connecting the pad to a suction pump so that negative pressure can be applied to the wound to draw fluids therefrom, and a canister for collecting fluids sucked from the wound. The apparatus described in the above application has proved to be clinically effective but there are some limitations in its use.

[0006] The apparatus described in the above PCT application is effective for treating a wide variety of different types and sizes of wounds. However, it may require the patient to undergo treatment on the apparatus for a long period. In cases where the patient is confined to bed this may not be a major problem but where the patient is mobile it means that he or she would be confined for long periods while the treatment takes place.

SUMMARY

[0007] According to one aspect of the present invention, there is provided a portable therapeutic apparatus for stimulating the healing of superficial wounds in a person, which comprises a housing containing a suction pump and a canister for containing fluids drawn from the wound by said pump, said canister including means for connection to a dressing in the region of the wound and a harness or belt for supporting the housing on the person.

[0008] Typically, the housing will have a curved surface on the side intended to be supported against the person’s body so as to make the apparatus more comfortable to wear. In addition, controls and indicators indicating the status of the treatment being applied to the wound are preferably located on the upper side of the housing so that the patient can easily see, e.g. the level of suction pressure being applied and the program for such treatment.

[0009] The suction pump is conveniently driven by an electric motor and batteries for such motor being contained within the housing. However, it is generally more convenient to provide a separate housing for the batteries since these can be placed on the belt or harness in such a way as to balance the weight of the housing, preferably in a housing shaped similarly to the housing for the pump and canister.

[0010] The canister should be removably mounted within the housing, e.g. by means of a latch or similar release mechanism, so that the canister can be readily removed and replaced when full.

[0011] In a portable therapeutic apparatus (in contrast with a static apparatus of the kind described in the above PCT application which cannot be easily carried by the patient), it is less easy to determine the pressure prevailing at the wound site being treated. This is because the pressure will depend, in part, upon the hydrostatic height between the pump and the wound being treated and this height may vary during the treatment, depending upon the patient’s movements. Apparatus in accordance with the invention overcomes this problem by providing an additional conduit connecting the wound site or an area close thereto to a pressure-detecting means, preferably located in the housing. The pressure-detecting means can be linked to a microprocessor programmed to maintain such pressure within a predetermined range irrespective of the movement of the patient. This can be done by, for example, signaling the pump to increase its speed where the hydrostatic pressure increases between the pump and the wound site or, conversely, reducing its speed where the hydrostatic pressure is reduced. This feature can also be used in a static therapeutic apparatus of the kind described in the above-mentioned application.

[0012] In the apparatus described in the above PCT application, the level of liquid in the canister is monitored by capacitance measurement. It has now been found that a simpler way of determining when the canister is filled is by measuring or detecting the pressure drop across the canister. The pressure drop can be increased by providing a filter barrier in the region of the outlet end of the canister.

[0013] Thus, when the liquid reaches a level within the canister so as to substantially occlude the filter, a sharp pressure change occurs in the conduit between the canister and the pump. By monitoring this pressure change, the point at which the canister is filled can be accurately determined.

[0014] Other features which are considered as characteristic for the invention are set forth in the appended claims.

[0015] Although the invention is illustrated and described herein as embodied in a wound treatment apparatus, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

[0016] The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a schematic layout of the apparatus in accordance with the invention.

[0018] FIG. 2A and B are pictorial representations of the housing of the pump and canister.

[0019] FIGS. 3A and B are pictorial representations of the apparatus supported on a belt and harness, respectively,
FIG. 4 is an exploded view of the housing showing the contents.

FIGS. 5A to 5F show various views of a preferred form of the canister and a section of a multi-lumen tube.

FIGS. 6A to 6D show various views of a foam dressing connector for connecting the housing to the dressing.

FIG. 6E shows a section of a modified multi-lumen tube, and

FIGS. 7A and 7B show a plan and perspective view of a surgical drape for use with the apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, the portable therapeutic apparatus comprises a housing 210 (best shown in FIGS. 2A and 2B), having rounded corners and a side 211 which is concavely curved in order to fit comfortably to the wearer’s body.

The shaping of the housing with curved surfaces is to avoid sharp corners or edges which could dig in to the user or his career. The upper surface 212 is generally flat and has an LCD screen 213 on which details such as applied pressure can be displayed. Control buttons 214 are provided to adjust pressures and treatment intervals. Provision is made for housing a canister within the housing and a snap release cover 215 is arranged for removing or introducing the canister.

FIGS. 3A and 3B show schematically ways in which the housing 210 may be supported on the patient’s body. In FIG. 3A, the housing 210 is supported on a belt 216 and is balanced by similarly rounded casing 217 containing a rechargeable battery pack. FIG. 3B shows an alternative arrangement in which the housing is supported on a harness 218 and again a battery pack is contained in a housing 219, also supported on the harness.

FIG. 4 shows an exploded view of the housing 210 indicating the main components within the housing. The housing consists of front and rear shell mouldings 1 and 2 having an external bet clip 21 for attachment to a belt or harness.

Within the housing shell 1 is located a suction pump 6 with associated electric motor 6A and the pump is connected by a silicon rubber tube 103 to a canister spigot 7A in a cavity 20 for the canister 100. Also connected to a second canister spigot 7B via a tube 10 is a pressure relief valve and both tubes 103 and 10 are connected via T-connectors T to pressure transducers (not shown). A microprocessor 4 is mounted on a PCB board S and a membrane assembly 3 incorporates an LCD indicator and control buttons.

The apparatus may include means for recording pressures and treatment conditions given to a particular patient which may be printed out subsequently by the physician. Alternatively, the equipment may include a modem and a telephone jack so that the conditions under which the patient has been treated can be interrogated by the physician from a distant station.

Canister 100 is a push fit into the cavity 20 and its lower end is supported in a cover 30. The cover 30 incorporates fingers 31 which are releasably engageable with lips 32 to hold the canister in position. The canister and the latch mechanism is arranged so that when the latch is engaged, the spigots 7A and 7B are in sealing engagement or abutment with tubular protrusions 33 and 34 formed in the top of the canister.

The method of operation of the apparatus can be appreciated from the schematic layout in FIG. 1, in which the canister 100 is connected via tube 101 to a porous dressing 102 at the wound site. Suction is applied to the wound site via the canister by a tube 103, connected to the pump 6. The pressure in the tube 103 is detected by the transducer 105.

A second tube 106 is connected to the wound site 102 at one end, and also to a pressure relief valve 8 and to a second transducer 108. Tubes 106 and 104 can be combined in a multi-partitioned tube in a manner to be described later. By means of tube 106 and transducer 108 the pressure at the wound site can be measured or monitored. A filter 109 is placed at or close to the outlet end of the canister 100 to prevent liquid or solid particles from entering the tube 103. The filter is a bacterial filter which is hydrophobic and preferably also lipophobic.

Then, aqueous and oily liquids will head on the surface of the filter. During normal use there is sufficient air flow through the filter such that the pressure drop across the filter is not substantial.

As soon as the liquid in the canister reaches a level where the filter is occluded, a much increased negative pressure occurs in tube 103 and is detected by transducer 105. Transducer 105 is connected circuitry which interprets such a pressure change as a filled canister and signals this by means of a message on the LCD and/or buzzer that the canister requires replacement. It may also automatically shut off the working of the pump.

In the event that is desired to apply intermittent suction to the wound site, a pressure relief valve 8 enables the pressure at the wound site to be brought to atmospheric pressure rapidly. Thus, if the apparatus is programmed, for example, to relieve pressure at 10 minute intervals, at these intervals valve 8 will open for a specified period, allowing the pressure to equilibrate at the wound site and then close to restore the suction. It will be appreciated that when the constant suction (or negative pressure) is being applied to the wound site, valve 8 remains closed and there is no leakage from atmosphere. In this state, it is possible to maintain negative pressure at the wound site without running the pump continuously, but only from time to time, to maintain a desired level of negative pressure (i.e., a desired pressure below atmospheric), which is detected by the transducer 105. This saves power and enables the appliance to operate for long periods on its battery power supply.

Instead of running two separate tubes to the wound site, it is preferable to contain tubes 106 and 101 in a single tube which is connected through the canister.

Thus, for example, tubes 103 and 101 may comprise an internal tube surrounded by an annular space represented by tube 106. This is illustrated in FIGS. 5A to 5F and is a modified form of FIG. 6E.

In an alternative embodiment, the multi-lumen tube may be constructed as shown in FIG. 6E. In this embodiment, the internal bore 606 comprises the line 101 (see FIG. 1) and is used to extract fluids from the wound site. Air flow (represented by line 106 in FIG. 1) passes down conduits 607 located within the walls of the tube. By spacing the conduits 607 at 90° intervals around the tube, the risk of arresting the air flow by kinking or twisting the multi-lumen tube is minimized.

FIG. 5E is a plan view of the top of a preferred shape of canister, the generally triangular shape in section being chosen to fit better the space within the cavity 20 (see FIG. 4).
Tubular protrusions on the top of the canister are connected internally of the canister with respectively conduits 124 and 121 (see sectional view of FIG. 5B), thus maintaining a separation between the tubes which are represented by lines 103 and 106 in FIG. 1. At the base of the canister, a moulding 125 facilitates connection to a multi-partitioned tube 126 shown in FIG. 5F. Tube 126 has a central bore 127 which is sized to fit over a spigot 128 in moulding 125. At the same time, the external wall of tube 126 seals against the inner wall 129 of moulding 125. Thus, compartment 124 will connect with central bore 127 and the compartment 121 will connect with the annular spaces 130 of tube 126. In this way, a conduit 130 corresponds with line 106 and central bore 127 with line 101 as shown in FIG. 1.

[0041] The partitioned tube need not continue all the way to the wound site 102, but can be connected to a short section of single bore tube close to the wound site.

[0042] In the event of an air leak in the dressing at the wound site 102, this can be detected by both transducers 105 and 108 reading sufficient negative pressure for a specific time period and then triggering a leak alarm, i.e. a message on the LCD, preferably also with an audible warning.

[0043] Typically, the pump 6 is a diaphragm pump but other types of pumps and equivalent components to those specifically employed may be substituted.

[0044] FIGS. 6A-6D show various views of a connector for attaching the multi-lumen tube at the wound site. FIG. 7A and 7B show a plan and perspective view of a surgical drape for attaching the connector to a porous dressing at the wound site. The connector comprises a moulded plastics disc-like cup 601 having a centrally positioned spout 602. The spout 602 is sized to accept, as a closely sliding fit, the end of a multi-lumen tube, e.g., of the kind shown in FIGS. 5F or 6E.

[0045] In use, a porous dressing is cut to correspond with the extent of the wound and pressed onto the wound as shown in FIG. 10 of our above cited PCT application WO 96/05873. Instead of introducing the lumens into the foam dressing, the cup 601 is pressed onto the porous dressing and secured by a surgical drape. However, if desired, the end of the lumen can be passed into the spout and additionally pressed into the foam. A surgical drape such as shown in FIGS. 7A and 7B, can be used to secure the connector, lumen and dressing. The drape comprises a polyurethane film 701 coated on one side with a pressure-sensitive acrylic resin adhesive. A hole 702 is cut through all layers of the drape and the hole is dimensioned to correspond approximately with the outer cross-section of the spout 602. Film 701 has an overall size which allows it to be adhered to the patient’s skin around the wound site, while at the same time, securing the connector to the porous dressing. A sufficient overlap around the wound is provided so that an airtight cavity is formed around the wound.

[0046] In an alternative form, the drape can be made in two parts, e.g. by cutting along the line X-X in FIG. 7A. With this arrangement, the wound can be sealed by overlapping two pieces of surgical drape so that they overlap each other along a line Y-Y as shown in FIG. 6D.

[0047] The surgical drape may include a protective film 703, e.g. of polyethylene, and a liner 704 which is stripped off prior to use to expose the pressure-sensitive adhesive layer. The polyurethane film may also include handling bars 705, 706, which are not coated with adhesive, to facilitate stretching of the film over the wound site. The dressing is preferably a pad of porous, flexible plastics foam, e.g. reticulated, open intercommunicating cellular flexible polyurethane foam, especially of the kind described in the above-mentioned PCT Application WO 96/05873.

[0048] Alternatively, a reticulated intercommunicating cellular foam made from flexible polyvinylacetate or polyvinyl alcohol foam may be used. The latter is advantageous because it is hydrophilic. Other hydrophilic open celled foams may be used.

[0049] In another method of therapy, the foam dressing may be sutured into a wound after surgery and the foam dressing connected to the pump unit by the multi-lumen catheter. Negative pressure can then be applied continuously or intermittently for a period determined by the surgeon, e.g. from about 6 hours to 4 to 5 days. After this period, the dressing is removed and the wound re-sutured.

[0050] This therapy improves the rate of granulation and healing of wounds after surgery.

1.-22. (canceled)
23. A method for securing a suction device to a wound site, the method comprising:

applying a connector to an open-celled polymer foam positioned at the wound site such that a flange of the connector contacts the open-celled polymer foam, the connector having a centrally-positioned spout configured to receive a suction tube; and

sealing the connector at the wound site with a drape such that the centrally-positioned spout extends through a hole of the drape.

24. The method of claim 23 further comprising:

prior to applying the suction head, positioning the open-celled polymer foam at the wound site.

25. The method of claim 23, wherein sealing the connector at the wound site further comprises:

adhesively securing the drape to the flange of the connector, the open-celled polymer foam, and skin surrounding the wound site.

26. The method of claim 23, wherein sealing the connector at the wound site further comprises:

stretching the drape over the connector and the open-celled polymer foam; and

adhesively securing the drape to skin surrounding the wound site.

27. The method of claim 23, wherein the open-celled polymer foam is a reticulated, polyurethane foam.

28. The method of claim 23, wherein the open-celled polymer foam is a polyvinyl alcohol foam.

29. A method for administering negative pressure wound site therapy to a wound site, the method comprising:

positioning an open-celled polymer foam at the wound site;

applying a connector having a flange and a centrally-positioned spout to the open-celled polymer foam such that a flange of the connector contacts the open-celled polymer foam;

securing the connector at the wound site with a drape such that the centrally-positioned spout extends through a hole of the drape; and

applying a negative pressure to the wound site through the centrally-positioned spout and open-celled polymer foam.

30. The method of claim 29 further comprising:

maintaining the negative pressure at the wound site with the drape positioned over the connector.
31. The method of claim 29, wherein sealing the suction head at the wound site further comprises:
   adhesively securing the drape to the flange of the connector, the open-celled polymer foam, and skin surrounding the wound site.

32. The method of claim 29, wherein sealing the connector at the wound site further comprises:
   stretching the drape over the connector and the open-celled polymer foam; and
   adhesively securing the drape to skin surrounding the wound site.

33. The method of claim 29, wherein the open-celled polymer foam is a reticulated, polyurethane foam.

34. The method of claim 29, wherein the open-celled polymer foam is a polyvinyl alcohol foam.

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