A fluid pump comprising a fluidic manifold comprising a plate constructed of a fluid-impermeable material. The plate has a pump platen, first fluid connectors, and second fluid connectors, and one or more channels formed therein for connecting the first connectors to the second connectors. The fluid pump has a fluid-impermeable membrane positioned on the plate and covering the one or more fluid channels to form one or more fluid paths. The fluid pump also has a pump tubing positioned on the pump platen, the pump tubing having a first part connected to a first one of the first fluid connectors and a second part connected to a second one of the first fluid connectors such that the pump tubing is fluidly connected to the channels via the first one and the second one of the first fluid connectors.
FACE DRIVE FLUID PUMP

CROSS REFERENCE TO RELATED APPLICATIONS


FIELD OF DISCLOSURE

[0002] The inventive concept disclosed herein generally relates to a fluid pump, and more particularly, but not by way of limitation, to a peristaltic pump having a two-part molded and bonded pump tubing, and an integrated fluidic manifold.

BACKGROUND

[0003] Peristaltic pumps generally operate by occluding or closing flexible tubing by applying pressure on the tubing wall with a roller or other protrusion, such as a cam or a finger, in order to produce a flow of a fluid within the flexible tubing. This process is called peristalsis and is used, for example, in the gastrointestinal tract of humans and animals. Peristaltic pumps are widely used in many industries, but particularly in the medical industry for pumping of body fluids or fluids to be received by a patient, because the fluid pumped is completely contained within the tubing, and no cross-contamination typically occurs. Another advantage of peristaltic pumps is that there is usually no need to provide valves, which could possibly leak, nor is there any contamination of the liquid to be pumped since the liquid is not contacted by component parts of the pump, lubricants used in the pump and so on. Typical medical applications include intravenous solution systems, feeding pumps, inhalation nebulizers, etc. In industrial applications, peristaltic pumps are widely used with aggressive or hazardous chemicals, high-solids slurries, or other abrasive fluids, and in applications where maintaining the fluid completely contained is important.

[0004] A typical peristaltic pump has static flexible tubing arranged in a part-circular form around the periphery of a pump rotor which carries a plurality of arcuate-spaced rollers and each of which engages and compresses the flexible tubing. To ensure a sufficient compression of the tubing, a sleeve usually surrounds the outer periphery of the tubing so that the compression takes place between the roller and the inner surface of the sleeve. Then, rotation of the pump rotor, liquid will be pumped around the tubing in the direction of rotation of the rollers, and by having a plurality of rollers so that at least two rollers are at all times engaged with, and compress, the tubing, back-leakage is prevented. More than two rollers and/or buffers are used in some applications to reduce pulsing of the pumped fluid.

[0005] In certain applications, such as medical testing for example, multiple fluids may need to be pumped and precisely measured. Due to the high-cost of some of the fluids and/or reagents used in some applications, it is desirable that the dead volume of fluids needed to prime and operate the pump is reduced as much as possible. Another desired feature is inputting a fluid supply from more than one inlet, and outputting fluid to more than one outlet, such that several tests may be performed on the same sample. Some tests require multiple steps, which may require one or more reagents to be pumped simultaneously or in a predetermined sequence.

[0006] Unfortunately, existing peristaltic pumps suffer from complicated designs and require large number of tubing connectors which can result in leaking and cross-contamination. Further, large manifolds with multiple connections extending from multiple sides of existing pumps result in a large “dead volume” i.e., an amount of fluid trapped in the various tubing connections and fluid paths. Further, existing pumps require the routing and connection of multiple sections of pump tubing, which creates the possibility for error and cross-contamination, and complicates assembly.

[0007] Therefore, a need exists for a fluid pump having a simple and easy to assemble integrated fluidic manifold with low dead-volume, multiple inlet/outlet connectors preferably disposed on a single side of the manifold, low manufacturing costs, simplified assembly, and improved reliability. It is to such a fluid pump that the inventive concept disclosed herein is directed.

SUMMARY

[0008] In one aspect, the inventive concept disclosed herein is directed to a fluid pump comprising a fluidic manifold which has a plate constructed of a fluid-impermeable material. The plate has a pump platen, first fluid connectors, and second fluid connectors, and one or more channels formed therein for connecting the first connectors to the second connectors. A fluid-impermeable membrane is positioned on the plate and covers the one or more fluid channels to form one or more fluid paths. A pump tubing is positioned on the pump platen, the pump tubing having a first part connected to a first one of the first fluid connectors and a second part connected to a second one of the first fluid connectors such that the pump tubing is fluidly connected to the channels via the first one and the second one of the first fluid connectors. A pump drive having two or more rollers engages the pump tubing and is movable in a path following the pump tubing from the first part to the second part, and a source is operably connected to the rollers and adapted to move the rollers through the path.

[0009] In another aspect, the inventive concept disclosed herein is directed to a fluid pump, comprising: a fluidic manifold. The fluidic manifold has a plate having a pump platen and a pump tubing positioned on the pump platen. The pump tubing has a first portion and a second portion bonded together to form a fluid impermeable connection, and a flow channel extending between a first part and a second part the first portion. The first portion is constructed of a fluid impermeable material and is positioned on the pump platen, the second portion is positioned on the first portion and formed of an elastomeric, fluid impermeable material. A pump drive has two or more rollers and engages the pump tubing. The rollers are movable in a path following the pump tubing from the first part to the second part to compress the first portion between the rollers and the pump platen. A source is operably connected to the rollers and adapted to move the rollers through the path.

[0010] In another aspect, the inventive concept disclosed herein is directed to a fluidic manifold comprising a plate constructed of a fluid-impermeable material. The plate has a pump platen, first fluid connectors, and second fluid connectors, and channels formed therein for connecting the first fluid connectors to the second fluid connectors. A fluid-impermeable membrane is positioned on the plate and covers the channels to form fluid paths.

[0011] In another aspect, the inventive concept disclosed herein is directed to a method for making a fluid pump,
comprising the steps of: connecting a first part of a pump tubing to a first one of first connectors of a plate of a fluidic manifold. The plate is constructed of a fluid impermeable material and includes channels connecting the first connector to second connectors. A second part of a pump tubing is connected to a second one of the first connectors of the plate of the fluidic manifold whereby the pump tubing is positioned on a pump platen of the plate of the fluidic manifold. The channels of the plate are covered, and rollers of a pump drive are applied to the pump tubing.

[0012] In yet another aspect, the inventive concept disclosed herein is directed to a fluid pump kit, comprising: a fluidic manifold with a plate constructed of a fluid impermeable material. The plate has a pump platen, first fluid connectors, and second fluid connectors, and one or more channels formed therein for connecting the first connectors to the second connectors. The kit further comprises a fluid impermeable membrane adapted to be positioned on the plate for covering the one or more channels to form one or more fluid paths. The kit also has a pump tubing sized to be positioned on the pump platen and having a first part adapted to be connected to a first one of the first fluid connectors and a second part adapted to be connected to a second one of the first fluid connectors. The kit further has a pump drive having two or more rollers adapted to engage the pump tubing and movable in a path following the pump tubing from the first part to the second part upon application of the two or more rollers to the pump tubing, and a source operably connected to the rollers and adapted to move the rollers through the path.

[0013] In yet another aspect, the inventive concept disclosed herein is directed to a pump tubing for a peristaltic pump having a fluidic manifold comprising a plate constructed of a fluid impermeable material. The plate has a pump platen, first fluid connectors, and second fluid connectors, and one or more channels formed therein for connecting the first connectors to the second connectors. The pump tubing comprises a first portion sized and adapted to be positioned on the pump platen and constructed of a fluid impermeable material, the first portion having a first part adapted to be connected to a first one of the first fluid connectors and a second part adapted to be connected to a second one of the first fluid connectors; and a second portion bonded to the first portion to form a fluid channel extending between the first part and the second part of the first portion, the second portion being constructed of an elastomeric, fluid impermeable material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a partial perspective view of an exemplary embodiment of a fluid pump according to the instant disclosure.
[0015] FIG. 2 is an exploded perspective view of the fluid pump shown in FIG. 1.
[0016] FIG. 3 is a perspective view of an exemplary embodiment of a fluidic manifold according to the instant disclosure.
[0017] FIG. 4 is a top view diagram of the fluidic manifold of FIG. 3 with fluid channels shown in phantom.
[0018] FIG. 5 is a bottom view of the fluidic manifold of FIG. 3 with the pump platen shown in phantom.
[0019] FIG. 6A is an exploded perspective view of an exemplary embodiment of a pump tubing according to the instant disclosure, having a first portion and a second portion.
[0020] FIG. 6B is a bottom perspective view of the first portion of the pump tubing shown in FIG. 6A.
[0021] FIG. 6C is a top perspective view of the second portion of the pump tubing shown in FIG. 6A.
[0022] FIG. 6D is a partial cross-sectional perspective view showing a pump tubing positioned on a pump platen according to the instant disclosure.
[0023] FIG. 7 is an exploded perspective view of an exemplary embodiment of a pump drive according to the instant disclosure.
[0024] FIG. 8 is a perspective view diagram of an exemplary embodiment of the fluid pump, showing a path that a fluid travels through the fluid pump.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0025] Before explaining at least one embodiment of the inventive concept in detail, it is to be understood that the inventive concept disclosed herein is not limited in its application to the details of construction, experiments, exemplary data, and/or the arrangement of the components set forth in the following description, or illustrated in the drawings. The inventive concept is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for purposes of description and should not be regarded as limiting.

[0026] The inventive concept disclosed herein generally relates to peristaltic fluid pumps. More particularly, but not by way of limitation, the inventive concept relates to a face-to-face peristaltic fluid pump having an integral fluidic manifold and two-part bonded pump tubing.

[0027] Referring now to the drawings and in particular to FIGS. 1 and 2, shown therein is an embodiment of a fluid pump 100 according to the instant disclosure. Generally, the fluid pump 100 comprises a fluidic manifold 102, a pump tubing 104, a pump drive 106, and an optional distribution valve 108.

[0028] Generally, the pump tubing 104 is placed on a pump platen 118, and the pump drive 106 is disposed on the pump tubing 104, such that a fluid may be pumped by rotating the pump drive 106 over the pump tubing 104. The fluid may enter the fluidic manifold 102 via a fluid connector 128a acting as an inlet, and exit the fluidic manifold 102 via a fluid connector 128b acting as an outlet.

[0029] Referring now to FIGS. 3-5, the fluidic manifold 102 comprises a plate 110 and a membrane 112 (FIGS. 1-2).

[0030] The plate 110 can be made of any suitable fluid impermeable material such as, for example, thermoplastics, plastics, metals, alloys, latex, silicone, and polyvinylchloride. The plate 110 is preferably molded, but it may be made by other suitable methods such as die cutting, for example. The plate 110 can have varying sizes depending on the particular applications of the fluid pump 100 according to the instant disclosure, but is preferably about the size of a credit card (e.g. about 3.5 in x 2 in).

[0031] The plate 110 is shown as being rectangular in shape, but it is to be understood that the plate 110 may have any shape, including square, triangular, circular, polygonal, elliptical, and any other suitable form, for example.

[0032] The plate 110 has a top surface 114 and a bottom surface 116. It is to be understood that the designations "top" and "bottom" are used herein solely for convenience and are meant to distinguish two surfaces that are opposite one
another. Such surfaces may also be designated as a first surface 114 and a second surface 116, for example. As will be understood by persons of ordinary skill in the art, the top surface 114 and the bottom surface 116 may be positioned at various angles relative to an external reference point or surface, such as a ground surface or a floor, for example, and may be disposed horizontally, vertically, or angled relative to such external reference point or surface. It is to be understood that while the top surface 114 and the bottom surface 116 are shown as being opposite and parallel to one another, the top surface 114 and the bottom surface 116 may be oriented in various angles relative to one another, including intersecting with one another in some exemplary embodiments of the plate 110 according to the inventive concept disclosed herein.

[0033] The top surface 114 preferably has at least one pump platen 118 formed therein. It is to be understood that while two pump platens 118 are shown, the inventive concept disclosed herein can work with one pump platen 118, two pump platens 118, and with more than two pump platens 118. The pump platen 118 is preferably molded as a unitary body with the plate 110, but may also be attached to the plate 110 by any suitable means, such as for example by bonding, gluing, and welding, such that a connection is formed between the pump platen 118 and the plate 110. The pump platen 118 is shown as having a circular shape and defining a first annular space 120 and a second annular space 122. At least two fluid connectors 123a−h are positioned within and/or adjacent to the first annular space 120. The first fluid connector 123a, for example, has two pump tubing attachment posts 124a and 124b which define fluid channels 125a and 125b therethrough. The first fluid connector 123b has two pump tubing attachment posts 124c and 124d which define fluid channels 125c and 125d therethrough. It should be understood that one pump tubing attachment post 124, or more than two pump tubing attachment posts 124a−n are contemplated to be used with the first fluid connector 123a and the first fluid connector 123b according to the instant inventive concept. The pump tubing attachment posts 124a−d may comprise a press-fit connector, a push-in connector, and/or any other suitable connector capable of forming a fluid-impermeable connection with the pump tubing 104 as will be described herein below. The pump tubing attachments posts 124a−d may also function to prevent rotation of the pump tubing 104 relative to the pump platen 118.

[0034] The plate 110 also preferably includes a retaining ring 126. The retaining ring 126 is preferably centered within the second annular space 122 and adapted to cooperate with the pump drive 106 such that the pump drive 106 is retained in a concentric position relative to the pump platen 118 as will be described below.

[0035] The top surface 114 further comprises a plurality of second fluid connectors 128a−m. The second fluid connectors 128a−m are adapted to form fluid-impermeable connections between an external fluid conduit (not shown) and the fluidic manifold 102. The second fluid connectors 128a−m may function as a fluid inlet and/or a fluid outlet depending on the particular implementation of the fluid pump 100. Alternatively, a first one of the second fluid connectors 128a functions as a fluid inlet, and a second one of the second fluid connectors 128b may function as a fluid outlet, as will be understood by persons of ordinary skill in the art. The second fluid connectors 128a−m are preferably disposed about the plate 110 such that the number of second fluid connectors 128a−m used to operate the fluid pump 100 is minimized, and are preferably made to fit conventional connector interfaces, as will be understood by persons of ordinary skill in the art.

[0036] The fluid pump 100 may also be provided with a base cart connector 129 (FIG. 1), which base cart connector 129 may be adapted to house a component, such as a pierce septum, for example, such that on installation of a cartridge containing a reagent bag or pouch, the pierce septum pierces the reagent bag or pouch and creates a fluid-impermeable connection between the pierce septum and the reagent bag or pouch at the top and the pierce septum and a fluid connector 128a at the bottom, as will be understood by persons of ordinary skill in the art.

[0037] The plate 110 is optionally provided with a distribution valve housing 130 for supporting the distribution valve 108. The distribution valve housing 130 preferably forms a circular wall so that the distribution valve 108 can be rotatably attached to the plate 110. The distribution valve housing 130 encloses a valve area 131. Two or more valve ports 132a−h are disposed in the valve area 131. In a preferred embodiment, one of the valve ports 132a can be a central port and the other valve ports 132b−h can be positioned around the central port in a hub and spoke configuration. The distribution valve 108 comprises a valve path 134 formed therein, such as, by molding, etching, machining, and combinations thereof, for example. The valve path 134 may be covered by a fluid-impermeable membrane 135, which may be bondingly connected to the distribution valve 108. The distribution valve housing 130 is adapted to house the distribution valve 108 (FIGS. 1 and 2), such that the optional distribution valve 108 can be operated to selectively connect two or more of the valve ports 132a−h via the valve path 134 to be in fluid communication with one another. The connections formed between the valve path 134 and the valve ports 132a−h are preferably substantially or completely fluid-impermeable. It is to be understood that while a circular distribution valve 108 is shown, the distribution valve 108 can have any shape capable of selectively connecting two or more of the valve ports 132a−h. For example, the distribution valve 108 can have a linear shape and be movable in a linear fashion to selectively connect two or more of the valve ports 132a−h, as will be understood by persons of ordinary skill in the art. It is to be further understood that the distribution valve 108 is optional, and that an exemplary embodiment of the inventive concept disclosed herein may omit such distribution valve 108, as will be appreciated by persons of ordinary skill in the art presented with the instant disclosure.

[0038] The bottom surface 116 of the plate 110 comprises a plurality of fluid channels 136 formed therein. The plurality of fluid channels 136 may be formed in the bottom surface 116 in any suitable manner, such as molded, machined, etched, curved, and combinations thereof, for example. The plurality of fluid channels 136 are preferably molded into the bottom surface 116. As shown in FIG. 4, certain of the fluid channels 136 are connected to the valve ports 132a−h such that the valve ports 132a−h are in fluid communication with a respective fluid channel 136. At least one of the fluid channels 136 is in fluid communication with a first one of the second fluid connectors 128a and a second one of the second fluid connectors 128b. Further, certain of the fluid channels 136 are in fluid communication with at least one of the fluid channels 128a−m of the first fluid connector 123a and the first fluid connector 123b.

[0039] The membrane 112 (FIG. 2) can be any fluid-impermeable membrane 112 capable of covering the plurality of
fluid channels 136, such that a plurality of fluid-impermeable fluid paths 138 are formed and bounded by the plate 110 and the membrane 112 such as plastic and/or metal. While the membrane 112 is shown as being substantially the same shape and size as the plate 110, it is to be understood that the membrane 112 may have varying shapes and sizes, and that two or more membranes 112 may be used with the inventive concept disclosed herein. The membrane 112 is preferably molded to the bottom surface 116 of the plate 110, such that a fluid-impermeable connection is formed between the membrane 112 and the bottom surface 116. It is to be understood, however, that the membrane 112 may be connected to the bottom surface 116 of the plate 110 in any suitable manner, including bonding, adhesion, ultrasonic welding, pressure fitting, and combinations thereof, for example. In an exemplary embodiment, the membrane 112 may comprise a self-adhesive sheet which is adapted to adhere to the bottom surface 116 of the plate 110, such that a fluid-impermeable connection may be formed between the membrane 112 and the bottom surface 116 of the plate 110.

As shown in FIG. 4, the fluid paths 138 defined by the membrane 112 and one or more of the fluid channels 136 are selectively connectable via the distribution valve 108 to a pair of valve ports 132a-b such that the valve ports 132a-b are in fluid communication with the respective fluid path 138. Respective ones of the fluid paths 138 are in fluid communication with each of the second fluid connectors 128a-n. The distribution valve 108 can be placed in a first position wherein the valve ports 132a and 132b are in fluid communication; a second position wherein the valve port 132a is in fluid communication with a valve port 132c, a third position wherein the valve port 132a is in fluid communication with the valve port 132d, for example. Similarly, the remaining valve ports 132e-h can be placed in fluid communication with the valve port 132a by operating the distribution valve 108 in this fashion. Further, one of the fluid paths 138 is in fluid communication with at least one of the first fluid connector 123a and the first fluid connector 123b. It is to be understood that various configurations of the fluid paths 138 may be used with the fluid connectors 123a and 123b. The fluid paths 138 may be used with the fluid connectors 123a and 123b for example. As will be understood by a person of ordinary skill in the art, the plurality of fluid paths 138, the pump tubing 104, the distribution valve 108, and the second fluid connectors 128a-n cooperate to allow for the transfer of fluids through the fluidic manifold 102 and can be customized for particular situations and/or needs.

Referring now to FIGS. 6A-6C, the pump tubing 104 comprises a first portion 140 and a second portion 142, which are preferably bonded together such that a fluid-impermeable connection is formed between the first portion 140 and the second portion 142 as will be described below.

The first portion 140 is preferably made from an elastomeric material, such as, for example, silicon or latex, which is capable of being compressed by the pump drive 106 as will be described below. The first portion 140 has a wall 141 which comprises a first part 144a, and a second part 144b. The first part 144a defines a first fluid cavity 146a formed therein, and the second part 144b defines a second fluid cavity 146b formed therein. The first fluid cavity 146a is defined by a tongue 148a, and the second fluid cavity 146b is defined by a tongue 148b. While the first portion 140 is shown as comprising a first part 144a and a second part 144b, it is to be understood that the first portion 140 may comprise one part 144, or may comprise more than two parts 144a-n, as will be appreciated by persons of ordinary skill in the art presented with the instant disclosure.

The first portion 140 further comprises two alignment notches 150 which may function to prevent the first portion 140 from rotating relative to the second portion 142 as will be described below.

The second portion 142 can be made of any suitable material, such as plastics, thermoplastics, elastomeric materials, latex, rubbers, composite materials, and metals, for example. The second portion 142 comprises a surface 152, fluid connectors 154, and alignment protrusions 156. The surface 152 has a first part 160a surrounded by a alignment groove 162a, a second part 160b surrounded by an alignment groove 162b, and fluid channels 164a-d in fluid communication with the fluid connectors 154.

Referring now to FIG. 6B, the surface 152 is adapted to matingly receive the first portion 140, such that the alignment notches 150 receive the alignment protrusions 156 therein, while at the same time, the tongue 148a is matingly received by the alignment groove 162a, and the tongue 148b is matingly received by the alignment groove 162b. While the first fluid cavity 146a and the first fluid cavity 146b are in fluid communication with fluid channels 164a and 164b, the first fluid cavity 146a and the second fluid part 160b cooperate to form a new flow path 166 in fluid communication with fluid channels 164c and 164d. The fluid channels 164a-d are in fluid communication with the fluid channels 128a-n, respectively.

The alignment notches 150 and the alignment protrusions cooperate with the tongues 148a-b, and the alignment grooves 162a-b to prevent the first portion 140 from rotating relative to the second portion 142. Further, a layer of adhesive (not shown) may be disposed within the alignment grooves 162a-b to ensure a fluid-impermeable connection between the first portion 140 and the second portion 142.

It is to be understood, however, that in an exemplary embodiment (not shown) the first portion 140 can comprise one part 144, and the second portion 142 may comprise one part 160, such that one flow path 166 is defined by the pump tubing 104. It is to be further understood that a single alignment notch 150, or more than two alignment notches 150 may be used with exemplary embodiments of the inventive concept disclosed herein. It is to be further understood that other alignment features may be used to align the first portion 140 and the second portion 142, such as, for example protrusions, grooves, notches, visual markings, and combinations thereof.

The fluid connectors 154 can be any fluid connectors that allow the pump tubing 104 to be fluidly connected to the first fluid connectors 123a-b. In an exemplary embodiment, the fluid connectors 154 may be press-fit fluid connectors 154 that are pressed into at least one of the first fluid connector 123a and the first fluid connector 123b, such that the pump tubing 104 is in fluid communication with at least one of the first fluid connector 123a and the first fluid connector 123b, and a fluid-impermeable connection is formed between at least one of the first fluid connector 123a and the first fluid connector 123b, and the fluid connectors 154.

The first portion 140 and the second portion 142 are preferably molded or otherwise bonded together such that a fluid-impermeable pump tubing 104 is formed by the connec-
tion between the first portion 140 and the second portion 142. As used herein the term bonded is not limited to using adhesives to connect the first portion 140 to the second portion 142, but may include cohesives, welds, ultrasonic bonding, and the like as will be understood by persons of ordinary skill in the art. It is to be understood that the first portion 140 and the second portion 142 may be formed as a unitary body, or may be connected to one another in any suitable manner, such as by pressure clamping, press-fitting, and combinations thereof, for example, as will be appreciated by persons of ordinary skill in the art. Further, while the wall 141 is shown as having a thickness X which is preferably from about 0.75 mm to about 5 mm, it is to be understood that such thickness is exemplary only, and the wall 141 may have varying thickness sufficient to provide the wall 141 with sufficient elasticity such that the wall 141 may be compressed by the pump drive 106, and automatically rebound to its uncompressed state when not being compressed by the pump drive 106 to draw fluid into the first flow path 166a and the second flow path 166b.

[0050] The pump drive 106 may be coupled with the plate 110 by any suitable means (not shown), such as a pivoting arm, for example. Alternatively, the pump drive 106 may not be physically attached to the plate 110, instead the pump drive 106 and the plate 110 may be attached to an optional external housing (not shown) which may function to provide structural support for the pump drive 106 and the plate 110. The optional external housing (not shown) may provide an insertion cavity (not shown) for the plate 110, and a hinged attachment frame (not shown) for the pump drive 106. The optional external housing (not shown) may comprise access doors or openings to allow access to the components by a user, and may have a control module and/or a control panel having various controls accessible by a user. Such external housings are well known in the art, and a detailed description is not deemed necessary herein to enable a person of ordinary skill in the art to implement such external housing with embodiments of the instant inventive concept.

[0051] Referring now to FIG. 7, the pump drive 106 comprises a source 168 having a drive shaft 170, and a pump roller 172 comprising a spider 174 and a plurality of rollers 176 (only 4 are shown for clarity) adapted to be rotated over the pump tubing 104. The pump drive 106 may be operably coupled to the plate 110 (directly and/or indirectly) in any suitable manner, such as via a hinged arm of an external housing (not shown), for example. Preferably, the pump drive 106 is operably coupled to the plate 110 in such a way that the pressure exerted upon the wall 141 of the pump tubing 104 by the pump drive 106 may be selectively varied by a user. In an exemplary embodiment, the pressure exerted or applied by the pump drive 106 on the wall 141 is exerted in an axial direction relative to the pump tubing 104, which axial direction is preferably also perpendicular to the top surface 114 of the plate 110.

[0052] The source 168 may be any source of mechanical power capable of rotating the pump roller 172 about the pump tubing 104, such as a direct current electrical motor, an alternating current electrical motor, and an internal combustion engine, for example. It is to be understood that the source 168 may be located remotely from the pump drive, provided that mechanical force can be applied to the drive shaft 170 by the source 168 via an operational linkage (not shown), such as a drive belt, or a drive chain, for example. It is to be understood that the speed with which the source 168 rotates the drive shaft 170 may be selectively adjusted by a user of the fluid pump 100, whether such adjustment is manual or automatically carried out by a control module (not shown).

[0053] The drive shaft 170 can be any conventional drive shaft operably coupled with the source 168 and the pump roller 172, and capable of transferring mechanical energy from the source 168 to the pump roller 172 such that the pump roller 172 can be moved in a path following the pump tubing 104. In an exemplary embodiment, a spring-loaded coupling (not shown) may be used to operably couple the pump roller 172 and the source 168, such that the pressure exerted by the pump roller 172 onto the pump tubing 104 may be selectively adjusted by a user. In another exemplary embodiment, the drive shaft 170 can be omitted, and the source 168 may be operably coupled with the pump roller 172. In an exemplary embodiment comprising two pump rollers 172, each of the two pump rollers 172 may be coupled to a separate source 168, or a source 168 may be coupled to two or more pump rollers 172.

[0054] The pump roller 172 comprises a plurality of rollers 176 and a spider 174. The rollers 176 are rotatably attached to the spider 174 such that the rollers 176 can engage the pump tubing 104 and rotate over the wall 141. The rollers are tapered relative to a rotational axis 177. Preferably, the rollers 176 engage the pump tubing 104 and are movable in a path following the wall 141 from the first part 144a to the second part 144b. In an exemplary embodiment two rollers 176 engage the first part 144a and two rollers 176 engage the second part 144b, but it is to be understood that any suitable number of rollers 176 may engage the first part 144a and the second part 144b at any given time. As will be understood by persons of ordinary skill in the art, the taper in the rollers 176 allows the rollers to rotate in a circular path such that slippage of the rollers 176 over the surface of the wall 141 of the pump tubing 104 is substantially avoided and radial scrub forces on the wall 141 are substantially or completely avoided. The rollers 176 may be made of any suitable resilient material having sufficient durability, such as metals, alloys, hard plastics, composite materials, and combinations thereof, for example. It is to be understood that while four rollers 176 are shown, the inventive concept disclosed herein may be used with any number of rollers 176, such as one roller 176, two rollers 176, three rollers 176, or four rollers 176, for example.

[0055] The pump roller 172 may further comprise a retaining ring insert 178, adopted to be matingly received by the retaining ring 126, such that the pump roller 172 and the pump plate 118 are maintained in a concentric orientation. As it will be appreciated by persons of ordinary skill in the art such feature is optional, and the concentric orientation of the pump roller 172 and the pump plate 118 may be maintained in a variety of ways, including mounting the pump drive 106 directly to the plate 110, for example. In an exemplary embodiment, the source 168 may be mounted on the bottom surface 116 of the plate 110 and the drive shaft 170 may extend through the plate 110 and through the retaining ring 126, such that the concentric orientation of the pump roller 172 and the pump plate 118 is maintained thereby.

[0056] In operation, the fluid pump 100 according to the instant inventive concept operates by positioning the pump tubing 104 on the pump plate 118, or otherwise connecting the pump tubing 104 to the pump plate 118, such that a fluid-impermeable connection is formed between the pump tubing 104 and the pump plate 118. Such connection may be formed for example, by press-fitting the fluid connectors 154
onto the pump tubing attachment posts 124a-d. Next one or more fluid inlets may be attached to one or more of the fluid connectors 128a-m. Similarly, one or more fluid outlets may be attached to one or more of the fluid connectors 128a-m. The distribution valve 108 may be selectively operated to fluidly connect two or more of the fluid connectors 128a-m via a valve port 132a-h to at least one of the first port 144a and the second port 144b of the pump tubing 104. The pump drive 106 is operated to rotate the rollers 176 over the wall 141 of the pump tubing 104, such that fluid is pumped through at least one of the first part 144a and the second part 144b of the wall 141.

[0057] Referring now to FIG. 8, shown therein is an exemplary embodiment of a path that a fluid may travel or take through the fluid pump 100. The fluid enters the pump manifold via a fluid connector 128b and is routed through a first fluid path 138a to the valve port 132a. The distribution valve 108 is positioned such that the valve port 132a is in fluid communication with the valve port 132a, through which the fluid is routed next. The fluid continues through a second fluid path 138b to the fluid connector 128f. From the fluid connector 128f, the fluid exits the fluidic manifold 102 via a fluid conduit 180 and is routed through an external device 182. The external device 182 may be, for example, another fluidic manifold 102, a sensor capable of sensing and/or detecting chemical or biological substances, a gas spectrometer, an NMR spectrometer, and infrared spectrometer, and combinations thereof. Next, a second fluid conduit 184 carries the fluid back into the fluidic manifold 102 via a fluid connector 128b. The fluid enters the pump tubing 104 via a fluid path 138c. The fluid is then pumped through the pump tubing 104 and through a fluid path 138d, by the operation of the pump drive 106. Finally, the fluid exits the manifold via a fluid connector 128e and is carried by a fluid conduit 186 to a waste receptacle (not shown). It is to be understood however that one or more fluids may take varying paths through a fluid pump 100 according to the instant inventive concept, and such one or more fluids may be pumped simultaneously, separately, or in any predetermined or random sequence by the fluid pump 100. One or more fluids may be pumped by the fluid pump 100 simultaneously in succession, via selective operation of the optional distribution valve 108 as described above. Alternatively, one or more fluids may be pumped by the fluid pump 100 via the same set of fluid paths 138, or via two or more sets of fluid paths 138a-n.

[0058] It will be understood from the foregoing description that various modifications and changes may be made in the preferred and alternative embodiments of the present inventive concept without departing from its scope and spirit.

[0059] This description is intended for purposes of illustration only and should not be construed in a limiting sense. The scope of this inventive concept should be determined only by the language of the claims that follow. The term “comprising” within the claims is intended to mean “including at least one” such that the recited listing of elements in a claim are an open group. “A,” “an” and other singular terms are intended to include the plural forms thereof unless specifically excluded.

1. A fluid pump comprising:
   a fluidic manifold comprising:
   a plate having a pump plate, first fluid connectors, and second fluid connectors, and one or more channels formed therein for connecting the first connectors to the second connectors;
   a fluid-impermeable membrane positioned on the plate and covering the one or more fluid channels to form one or more fluid paths;
   a pump tubing positioned on the pump plate, the pump tubing having a first portion connected to a first one of the first fluid connectors and a second portion connected to a second one of the first fluid connectors such that the pump tubing is fluidly connected to the channels via the first one and the second one of the first fluid connectors;
   a pump drive having two or more rollers engaging the pump tubing and movable in a path following the pump tubing from the first part to the second part, and a source operably connected to the rollers and adapted to move the rollers through the path.

2. The fluid pump of claim 1, wherein the pump tubing comprises two or more portions bonded together such that the pump tubing is substantially impermeable to fluids.

3. The fluid pump of claim 1, wherein the pump tubing comprises a top elastomeric portion and a bottom portion bonded to the top elastomeric portion, such that a fluid-impermeable fluid channel is formed by the top portion and the bottom portion.

4. The fluid pump of claim 1, wherein the fluidic manifold further comprises a valve operably connected to one or more of the fluid paths and operable to selectively direct fluid flow through the plate of the fluidic manifold.

5. The fluid pump of claim 1, wherein the fluidic manifold comprises a top surface and a bottom surface, and wherein the pump plate extends from the top surface and the fluid channels are formed in the bottom surface.

6. The fluid pump of claim 1, wherein the plate is substantially rectangular in shape.

7. The fluid pump of claim 1, wherein the two or more rollers are tapered relative to a rotation axis, such that the rollers are rotatable over an exterior surface of the pump tubing.

8. The fluid pump of claim 1, wherein the first fluid connectors define press-fit connections.

9. A fluid pump, comprising:
   a fluidic manifold comprising:
   a plate having a pump plate;
   a pump tubing positioned on the pump plate, the pump tubing having a first portion and a second portion bonded together to form a fluid impermeable connection and a flow channel extending between a first part and a second part the first portion, the first portion being constructed of a fluid impermeable material and positioned on the pump plate, the second portion positioned on the first portion and formed of an elastomeric, fluid impermeable material;
   a pump drive having two or more rollers engaging the pump tubing and movable in a path following the pump tubing from the first part to the second part to compress the first portion between the rollers and the pump plate, and a source operably connected to the rollers and adapted to move the rollers through the path.

10. The fluid pump of claim 9, wherein the plate includes first fluid connectors and wherein the first part is connected to a first one of the first fluid connectors, and the second part is connected a second one of the first fluid connectors.

11. The fluid pump of claim 10, wherein the first fluid connectors define press-fit connectors.
12. A fluidic manifold comprising:
a plate constructed of a fluid-impermeable material, the
plate having a pump platen, first fluid connectors, and
second fluid connectors, and channels formed therein
for connecting the first fluid connectors to the second
fluid connectors; and
a fluid-impermeable membrane positioned onto the plate
and covering the channels to form fluid paths.
13. The fluidic manifold of claim 12, further comprising a
first surface and a second surface opposite from the first
surface, and wherein the pump platen is positioned on the first
surface and the channels are formed in the second surface.
14. The fluidic manifold of claim 12, wherein the first fluid
connectors define press-fit connections.
15. (canceled)
16. (canceled)
17. (canceled)
18. (canceled)