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(54) Pipetting Head

(57) A pipetting head is provided for dispensing small volumes of liquid. The pipetting head comprises a dispensing tube from one end of which liquid can be ejected in use; a supply tube through which liquid is supplied to the other end of the dispensing tube in use; and means for moving the supply tube and the dispensing tube relatively towards one another, thereby reducing the volume of liquid which can be contained in the supply and dispensing tubes to cause liquid to be ejected from the one end of dispensing tube opposite the supply tube.

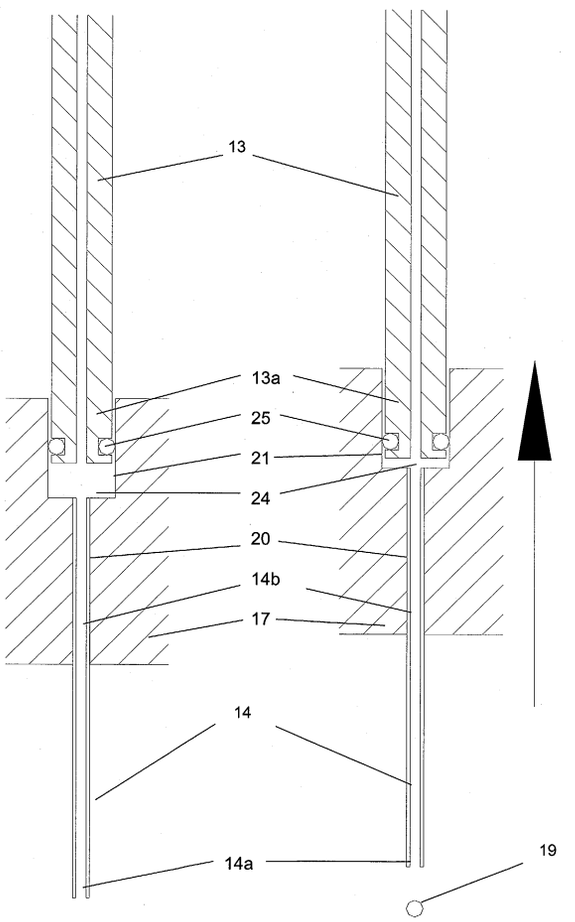

Figure 2

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Description

[0001] The present invention relates to low volume dispensing systems such as those used in automated laboratory situations for dispensing reagents and solutions.

[0002] It is well known, in a number of diverse areas of technology, to require to dispense small volumes of liquid. A conventional pipetting head type of dispensing apparatus has an array of cylinders, pistons and seals forming syringes that may be used to draw fluid from a reservoir into a syringe. Once the syringe has been filled from the reservoir the fluid can be dispensed. The minimum size of the droplet that can be dispensed depends on the size and shape of the dispensing tip and also the speed at which the liquid is ejected from the tip. Another factor that affects this phenomenon is the surface tension of the fluid to be dispensed as a fluid with a high surface tension is more likely to stick to the dispensing tip than a fluid with a low surface tension. Using this conventional form of liquid dispensing apparatus the smallest volume that can normally be dispensed is around 0.5 μl, below this volume it is not possible to use conventional pipetting techniques as the surface tension forces are too great and the droplets fail to leave the end of the pipette. In such circumstances it is necessary to use high velocity dispensing to eject the droplets from the end of the pipette at high speeds and thus overcome the surface tension forces. There are many tens of thousands of these conventional pipettes in use.

[0003] The present invention is designed to aspirate and non-contactingly dispense small volumes of liquid in the range of 5 to 500 nl.

[0004] According to the present invention there is provided a pipetting head for dispensing small volumes of liquid, comprising a dispensing tube from one end of which liquid can be ejected in use; a supply tube through which liquid is supplied to the other end of the dispensing tube in use; and means for moving the supply tube and the dispensing tube relatively towards one another, thereby reducing the volume of liquid which can be contained in the supply and dispensing tubes to cause liquid to be ejected from the one end of dispensing tube opposite the supply tube.

[0005] Preferably, the means for moving the supply tube and the dispensing tube relatively towards one another includes a first support for the supply tube, a second support in which the dispensing tube is fixedly mounted, and means for moving the first support and second supports relatively towards one another.

[0006] Preferably, the means for moving the first support and second supports relatively towards one another includes one or more piezoelectric transducers.

[0007] The pipetting head may further include a piston and cylinder assembly connected to the supply tube to supply liquid, under pressure, to the supply tube in use.

[0008] There is also provided a pipetting array comprising a row of pipetting heads according the present invention, disposed parallel to one another and having a common means for moving the supply tube and the dispensing tube relatively towards one another.

[0009] Preferably, the common means for moving the supply tube and the dispensing tube relatively towards one another comprises a first plate in which the supply tubes are fixedly mounted, a second plate in which the dispensing tubes are fixedly mounted, and means for moving the first and second relatively towards one another.

[0010] Preferably, the means for moving the first support and second supports or plates relatively towards one another includes one or more piezoelectric transducers.

[0011] Preferably, each of the dispensing tubes connects with a respective counter-bore in the second plate.

[0012] The pipetting head may further comprise a compressible resilient member connecting the dispensing tube and the supply tube and through which the liquid passes, in use, and the end of the respective supply tube is disposed in the counter-bore against the annular resilient ring. This compressible resilient member may comprises an annular resilient ring, which may be a rubber ring, disposed in the counter-bore.

[0013] Existing conventional pipette heads may be adapted in accordance with the present invention to improve the minimum dispense volume by a factor of 100 or more.

[0014] One example of a pipetting assembly according to the present invention will now be further described with reference to the accompanying drawings in which:

Figure 1 shows a cross-section part of a pipetting head; and

Figure 2 shows a cross-section of a pipetting array according to the present invention.

[0015] As shown in the figures, each pipette head 11 comprises a piston 12, which is located in a bore 22 in a support plate or manifold 23 and which connects to a fluid supply tube 13, and a dispensing tube 14. The dispensing tube 14 dispenses liquid from one end 14a, in use. The end 14a is of constant cross sectional area and has no taper.

[0016] Figure 1 shows a pipetting array 10 which comprises a number of pipette heads 11 of the present invention arranged in a row in a substantially parallel configuration. The pipetting heads 11 have a common means for moving the supply tube 13 and the dispensing tube 14 relatively towards one another, in the form of one or more stacks of piezoelectric transducers 16, which enables all the pipetting heads to dispense together. The supply tubes 13 are fixedly mounted at their top ends 13b (as shown) in a static plate 15 and the dispensing tubes 14 are mounted at their upper ends 14b in an impact plate 17. The impact plate 17 is movable relative to the static plate 15 by means of the piezoelectric transducers 16.

[0017] Each dispensing tube 14 is securely mounted in a bore 20 in the impact plate 17 and the respective supply tube 13 has its lower end 13a engaged in a corresponding counter-bore 21, but can move up and down relative to the impact plate with its end 13a within the counter-bore 21. Between the lower end 13a of fluid supply tube 13 and the upper end 14b of the dispensing tube 14 a space 24 is created that is filled by the fluid to be dispensed. The lower end 13b of the supply tube 13 is sealed to the counter-bore 21 by an O-ring seal 25 as shown in Figure 2. In one example of the present invention the dispensing tube 14 is a metal tube of 0.1 - 0.3 mm bore.

[0018] Figure 2 shows a detailed cross-section of one piston 12, fluid supply tube 13 and dispensing tip 14 supported in the static and impact plates 15,17.

[0019] In order to dispense fluid, the pipette head pistons 12 are first advanced in their bores 22 to fill the dispensing tubes 14 and then the transducers 16 are actuated to cause the impact plate 17 to move rapidly relatively towards the static plate 15 in order to reduce the volume of the space 24 formed between the lower end 13a of fluid supply tube 13 and the upper end 14b of the dispensing tube 14 and thereby cause the ejection of one or more droplets of the fluid 19 to be dispensed. The transducers 16 then return the dispensing tubes 14 to their original position before the dispense cycle is repeated.

[0020] During the operation of the pipetting array 10, a wash liquid may first be aspirated up through the dispensing tips 14 into the fluid supply tube 13. Subsequently, a small amount of air can be aspirated before aspirating the fluid 19 to be dispensed. The air gap helps to prevent the fluid 19 to be dispensed and the wash liquid from mixing.

[0021] In another example of the present invention the space created between the lower end 13a of the fluid supply tube 13 and the upper end 14b of the dispensing tube 14 a spaced apart by a ring of compressible material, for example a rubber ring, located in the counter-bore 21. The ring of compressible material is connected to the fluid supply tube 13. The ring of compressible material is constrained by the counter-bore 21 in the impact plate 17 so that the internal diameter of the rubber ring reduces when longitudinally compressed by being squeezed between the opposed ends 13a, 14b of the supply tube 13 and the dispensing tube 14. The dispensing of fluid in this example of the present invention occurs as a result of squeezing the flexible ring by the relative movement of the static plate 15 and the impact plate 17. The amount of fluid dispensed is determined by the compression of the ring.

Claims

1. A pipetting head for dispensing small volumes of liquid, comprising

a dispensing tube from one end of which liquid can be ejected in use;

a supply tube through which liquid is supplied to the other end of the dispensing tube in use; and

means for moving the supply tube and the dispensing tube relatively towards one another, thereby reducing the volume of liquid which can be contained in the supply and dispensing tubes to cause liquid to be ejected from the one end of dispensing tube opposite the supply tube.

2. A pipetting head according to claim 1, wherein the means for moving the supply tube and the dispensing tube relatively towards one another includes

a first support for the supply tube, a second support in which the dispensing tube is fixedly mounted, and means for moving the first support and second supports relatively towards one another.

3. A pipetting head according to claim 2, wherein the means for moving the first support and second supports relatively towards one another includes one or more piezoelectric transducers.

4. A pipetting head according to any of claims 1 to 3, further including a piston and cylinder assembly connected to the supply tube to supply liquid, under pressure, to the supply tube in use.

5. A pipetting head according to any of claims 1 to 4, wherein the dispensing tube is fixedly mounted in a bore in a support plate and supply tube connects with a respective counter-bore in the support plate.

6. A pipetting head according to any one of claims 1 to 5, further comprising a compressible resilient member connecting the dispensing tube and the supply tube and through which the liquid passes, in use.

7. A pipetting head according to claim 2, wherein the compressible resilient member comprises an annular resilient ring.

8. A pipetting head according to claims 5, 6 and 7, wherein the annular resilient ring forms is disposed in the counter-bore, and the end of the supply tube is disposed in the counter-bore against the annular resilient ring.

9. A pipetting head according to claim 7 or claim 8, wherein the annular resilient ring is a rubber ring.

10. A pipetting array comprising a row of pipetting heads according to any of claims 1 to 9, disposed parallel to one another and having a common means for moving the supply tubes and the dis-

pensing tubes relatively towards one another.

11. A pipetting array according to claim 10, wherein the common means for moving the supply tube and the dispensing tube relatively towards one another comprises a first plate in which the supply tubes are fixedly mounted, a second plate in which the dispensing tubes are fixedly mounted, and means for moving the first and second plates relatively towards one another.

12. A pipetting array according to claim 11, wherein the means for moving the first support and second plates relatively towards one another includes one or more piezoelectric transducers.

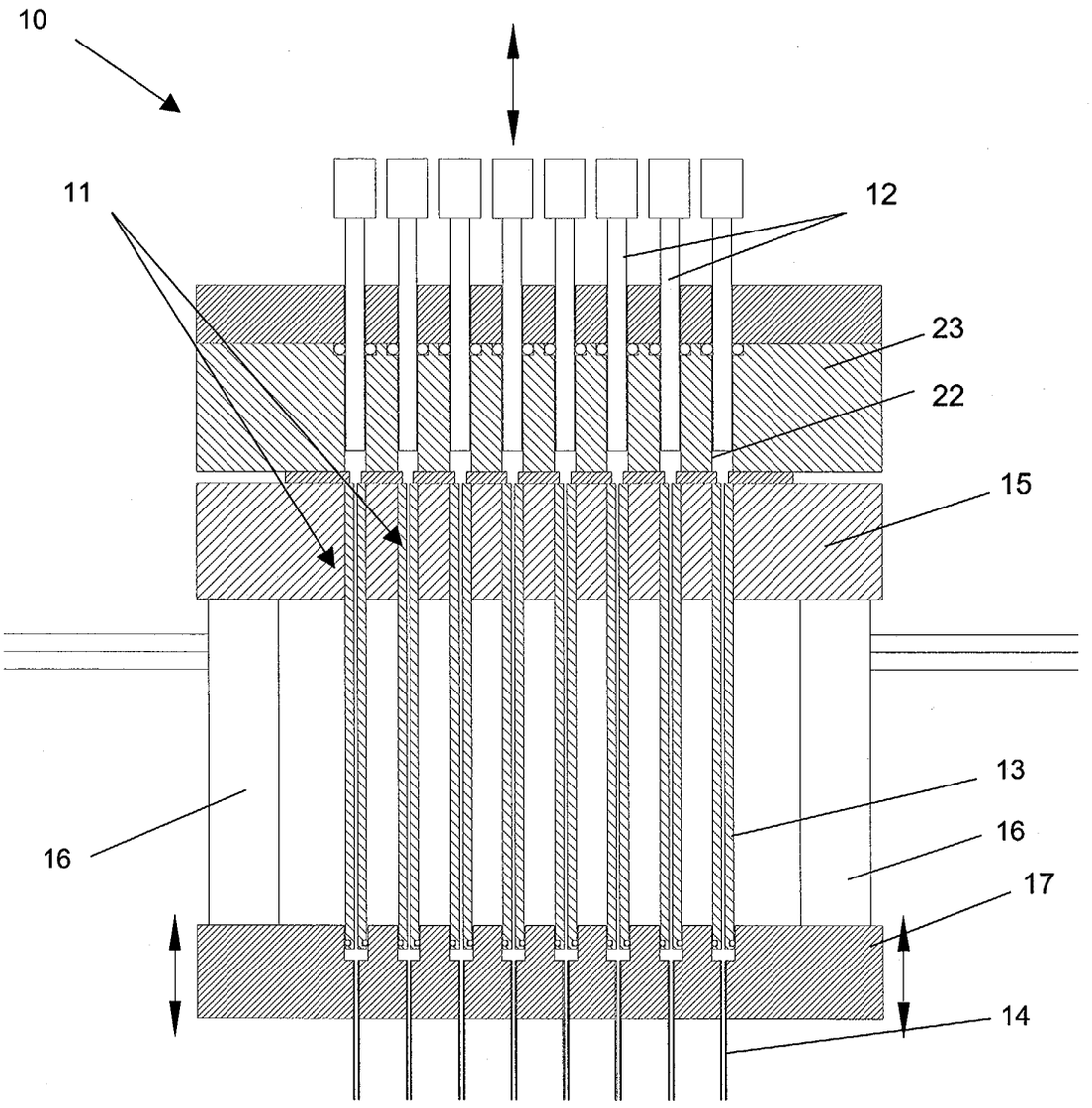

Figure 1

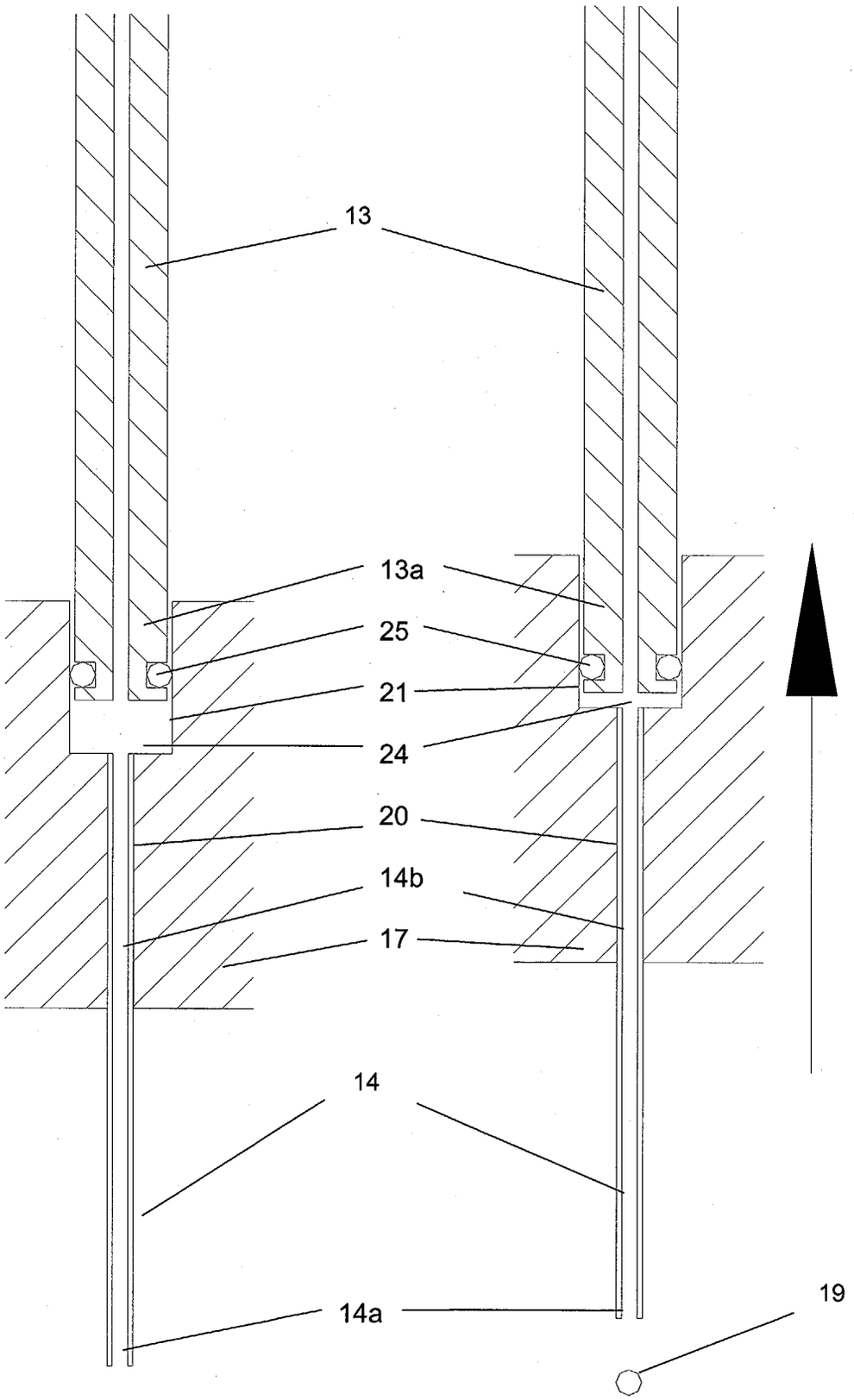

Figure 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 5031

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 January 2004	Wyplosz, N

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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