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(71) Applicant(s)
**Matrix Technologies Corporation**

(72) Inventor(s)
**Cote, Richard;Lacroix, Christopher P.**

(74) Agent / Attorney
**Spruson & Ferguson, Level 35 St Martins Tower 31 Market Street, Sydney, NSW, 2000**

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(71) Applicant *(for all designated States except US)*: **MATRIX TECHNOLOGIES CORPORATION** [US/US]; 22 Friars Drive, Hudson, MA 03051 (US).

(72) Inventors: **COTE, Richard**; 24 Rocky Dundee Road, Bolton, MA 01740 (US). **LACROIX, Christopher, P.**; 241 Cross Street, Winchester, MA 01890 (US).

(74) Agents: **GAUTHIER, Maurice, E.** et al.; Gauthier & Connors LLP, 225 Franklin Street, Suite 3300, Boston, MA 02110 (US).

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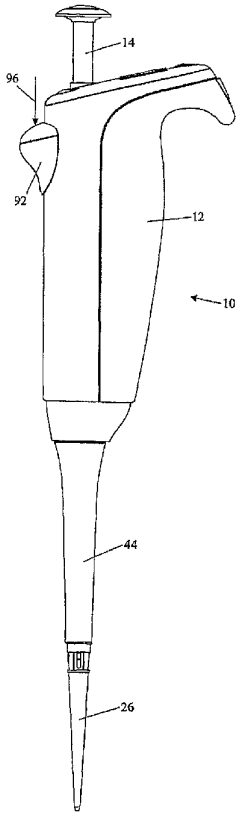
(54) Title: PIPETTE TIP MOUNTING AND EJECTION ASSEMBLY AND ASSOCIATED PIPETTE TIP




(57) Abstract: An air displacement pipette (10) has a tubular pipette tip (26) with an upper section surrounding a locking chamber, and a body section leading from the upper section and tapering downwardly to a reduced diameter end. A tubular mounting shaft on the pipette has a distal end configured and dimensioned for axial insertion into the locking chamber of the pipette tip (26). Coacting surfaces on the distal end of the mounting shaft and the upper section of the pipette tip establish an axially interengaged relationship between the pipette tip and the mounting shaft in response to insertion of the distal end of the mounting shaft into the locking chamber. A sleeve (44) is axially shiftable on the mounting shaft between a retracted position accommodating the establishment of the axially interengaged relationship, and an advanced position disrupting the axially interengaged relationship to thereby accommodate axial ejection of the pipette tip (26) from the mounting shaft.

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# PIPETTE TIP MOUNTING AND EJECTION ASSEMBLY AND ASSOCIATED PIPETTE TIP

## CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority from Provisional Application Serial No. 60/543,742 filed February 11, 2004.

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to air displacement pipettes, and is concerned in particular with an improvement in pipette tips and the manner in which they are releasably retained on and ejected from the tubular mounting shafts of the pipettes.

## DESCRIPTION OF THE PRIOR ART

It is known to detachably retain a pipette tip on the tubular mounting shaft of an air displacement pipette. The pipette is equipped with a manually operable ejection mechanism for disengaging and releasing the thus retained pipette tip once it has served its purpose. Retention is commonly achieved by effecting a friction fit between coacting surfaces on the pipette tip and the mounting shaft.

This leads to certain difficulties in that users are often uncertain as to the level of force required to achieve a secure friction fit. An inadequate force can result in the pipette tip becoming prematurely dislodged, whereas an excessive force can result in the pipette tip being jammed in place, which in turn disadvantageously increases the force that must be exerted by the manually operable ejection mechanism when dislodging the pipette tip from its retained position. These problems are exacerbated in multi channel pipettes.

It is also known to provide the cylindrical walls defining the upper ends of the pipette tips with interiorly projecting circular ribs or ridges designed to coact in snap engagement with mating surfaces on the tubular mounting shafts of the pipettes.

However, this also leads to certain difficulties in that in order to achieve a snap engagement, the upper walls of the pipette tips must be radially expanded, which in turn requires the user to exert unacceptably high forces when axially inserting the tubular mounting shafts into the pipette tips. Comparable forces are required to disengage the tips from the mounting shafts. Moreover, slight dimensional variations can have a significant impact, e. g. , by either additionally increasing the forces required to engage and release the pipette tips if their internal wall diameters are too small, or resulting in unacceptably loose connections if their internal wall diameters are too large.

## OBJECT OF THE INVENTION

It is the object of the present invention to substantially overcome or at least ameliorate one or more of the prior art disadvantages or at least provide a useful alternative.

## SUMMARY OF THE INVENTION

In one aspect, the present invention provides a pipette system, comprising:

a tubular pipette tip having an upper section surrounding a locking chamber, and a body section leading from said upper section and tapering downwardly to a reduced diameter end;

a tubular mounting shaft on said pipette, said mounting shaft having a distal end configured and dimensioned for axial insertion into said locking chamber;

coacting surfaces on the distal end of said mounting shaft and said upper section for establishing an axially interengaged relationship between said pipette tip and said mounting shaft in response to insertion of the distal end of said mounting shaft into said locking chamber; and

a sleeve movable relative to said mounting shaft between a retracted position accommodating the establishment of said axially interengaged relationship, and an advanced position disrupting said interengaged relationship to thereby accommodate axial ejection of said pipette tip from said mounting shaft;

wherein, in said advanced position, said sleeve is disposed between an inner surface of the upper section of said pipette tip and an outer surface of said tubular mounting shaft of said pipette so as to engage and deflect the inner surface of the pipette tip relative to the outer surface of the mounting shaft to eject said pipette tip.

In another aspect, the present invention provides a tubular pipette tip for use with a pipette having a mounting shaft defining a first interlocking surface, the pipette tip comprising:

an upper section surrounding a locking chamber;

a body section leading from said upper section and tapering downwardly to a reduced diameter end; and

a second interlocking surface on said upper section, said second interlocking surface being deflectable relative to said upper section and adapted to engage the first interlocking surface and to cooperate with the first interlocking surface such that said pipette tip is mechanically interlocked with the pipette when said pipette tip is received on the mounting shaft.

In another aspect, the present invention provides a pipette system, comprising:

a tubular pipette tip having an upper section surrounding a locking chamber, and a body section leading from said upper section and tapering downwardly to a reduced diameter end;

a tubular mounting shaft on said pipette, said mounting shaft having a distal end configured and dimensioned for axial insertion into said locking chamber;

coacting surfaces on the distal end of said mounting shaft and said upper section for establishing an axially interengaged relationship between said pipette tip and said mounting shaft in response to insertion of the distal end of said mounting shaft into said locking chamber, said coacting surfaces comprising a plurality of circumferentially spaced resilient fingers on the upper crown section of said pipette tip, said fingers being configured and arranged to project into said locking chamber and to snap inwardly into said interengaged relationship with an exterior surface on the distal end of said mounting shaft;

a sleeve movable relative to said mounting shaft between a retracted position accommodating the establishment of said axially interengaged relationship, and an advanced position disrupting said interengaged relationship to thereby accommodate axial ejection of said pipette tip from said mounting shaft;

first spring means for exerting a first axial force urging said sleeve into said retracted position;

a mechanism for overcoming said first axial force to shift said sleeve from said retracted position to said advanced position;

a collar axially shiftable on said sleeve between advanced and retracted positions; and

second spring means for exerting a second axial force urging said collar into its advanced position, said collar being engagable by the upper section of said pipette tip during insertion of the distal end of said mounting shaft into said locking chamber, and

being shifted against said second axial force from its advanced position to its retracted position during establishment of the axially interengaged relationship between said pipette tip and said mounting shaft, with the shifting of said collar from its advanced position to its retracted position being accompanied by an increase of said second force to an elevated level, whereby upon disruption of said interengaged relationship, said second force at said elevated level operates to forcibly eject said pipette tip from said mounting shaft by returning said collar to its advanced position.

In another aspect, the present invention provides a liquid handling system, comprising:

a tubular tip having an upper section and a body section leading from said upper section;

a tubular mounting shaft on said liquid handling system, said mounting shaft having a distal end configured to engage said upper section;

coacting surfaces on the distal end of said mounting shaft and said upper section for establishing an interengaged relationship between said tip and said mounting shaft; and

a sleeve movable relative to said mounting shaft between a retracted position accommodating the establishment of said interengaged relationship, and an advanced position for disrupting said interengaged relationship to thereby accommodate axial ejection of said tip from said mounting shaft;

wherein, in said advanced position, said sleeve is disposed between an inner surface of the upper section of said pipette tip and an outer surface of said tubular mounting shaft of said pipette so as to engage and deflect the inner surface of the pipette tip relative to the outer surface of the mounting shaft to eject said pipette tip.

In another aspect, the present invention provides a pipette system, comprising:

a pipette including a mounting shaft;

a pipette tip configured to be received on said mounting shaft;

first locking structure on said mounting shaft;

second locking structure on said pipette tip;

said first and second locking structures cooperating when engaged to mechanically lock said pipette tip against axial movement along said mounting shaft;

said second locking structure being movable from a first position wherein said pipette tip is mechanically locked with said mounting shaft, to a second position wherein said first and second locking structure are disengaged; and

a sleeve movable relative to said mounting shaft to engage and move said second locking structure from said first position to said second position when said sleeve is disposed between an inner surface of the second locking structure of said pipette tip and an outer surface of the first locking structure of said mounting shaft of said pipette.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side view of a manually operable air displacement pipette incorporating the concepts of the present invention;

Figure 2 is an enlarged vertical sectional view through the tip mounting and ejection assembly of the pipette illustrated in Figure 1, with the pipette tip separated therefrom;

Figure 3 is a further enlarged vertical sectional view of the end portion of the tip mounting and ejection assembly shown in Figures 1 and 2;

Figure 4 is a side view of the pipette tip shown in Figures 1 and 2;

Figure 5 is a vertical sectional view of the pipette tip taken on line 5-5 of Figure 4;

Figure 6 is a top plan view of the pipette tip;

Figure 7 is a perspective view of the crown section of the pipette tip ;

Figures 8-11 are views similar to Figure 3 showing successive stages in the tip mounting and ejection sequence;

Figures 12A, 13A, 14A and 15A are side views of alternative pipette tip embodiments; Figures 12B, 13B, 14B and 15B are vertical sectional views, respectively, of the pipette tip embodiments shown in Figures 12A, 13A, 14A and 15A; and =

Figure 16 is a partial sectional view showing the pipette tip of Figure 15A and 15B axially interengaged with the mounting shaft of the pipette.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference initially to Figures 1-3, a manually operable air displacement pipette incorporating concepts of the present invention is generally depicted at 10. The pipette includes a housing 12 with a manually operable push button 14 at its upper end. The push

button is connected via internal components (not shown) to a piston 16 projecting from the lower end of the housing. The piston 16 extends through a seal assembly 18 contained in the enlarged diameter head 20 of an aspirating and dispensing cylinder 22. The cylinder is threaded into the lower end of the housing and communicates with an integral tubular mounting shaft 24 with a distal end configured and dimensioned to removably retain a disposable pipette tip 26.

As can best be seen in Figure 3, the mounting shaft 24 is threaded into the cylinder end as at 28, with its reduced diameter coacting with the end of the cylinder 22 to form a circular shoulder 30. The distal end of the mounting shaft 24 is externally configured with an enlarged diameter shoulder 32 optionally having a chamfered leading edge 34. An intermediate surface 36 tapers inwardly from shoulder 32 to a circular groove 37 containing a resilient O-ring seal 38. A cylindrical section 40 extends from the groove 37 to an end surface 42.

A sleeve 44 surrounds the aspirating and dispensing cylinder 22 and its tubular shaft extension 24. As can best be seen in Figure 2, the upper end of sleeve 44 is spaced radially from the exterior surface of cylinder head 20 to define an annular space containing a first coiled compression spring 46. The spring 46 is axially confined between an external shoulder 48 on cylinder head 20 and a spring retainer 50 snap fitted into the upper sleeve end. Spring 46 resiliently urges sleeve 44 into a retracted position at which an internal sleeve shoulder 44′ contacts the shoulder 30.

Sleeve 44 includes a cylindrical press fitted insert 54 formed with an enlarged diameter end 56 having a chamfered or radiused leading edge 58. A collar 60 surrounds and is axially shiftable on the sleeve insert 54.

The lower interior of sleeve 44 is spaced radially from the exterior of insert 54 to define an annular spaced containing a second coiled compression spring 62. Spring 62 is axially confined between an internal shoulder 64 on sleeve 44 and the collar 60. The spring

62 serves to resiliently urge the collar 60 against the enlarged diameter end 56 of sleeve insert 54.

As can best be seen in Figures 4-7, the pipette tip 26 has a tubular configuration with an upper section having an upper wall segment 67 surrounding a locking chamber 68 and a lower wall segment 69 surrounding a sealing chamber 70. A body section 72 extends downwardly from the upper section 66 to a reduced diameter open end 74. The upper wall segment 67 of section 66 is formed with at least one and preferably a plurality of circumferentially spaced resilient fingers 76. Preferably, as shown, a pair of resilient fingers 76 are provided in an oppositely disposed relationship. The fingers 76 border and project inwardly in cantilever fashion from an upper chamfered rim 78 into the locking chamber 68. The lower wall segment 69 is interiorly provided with an entry section 80 tapering inwardly to a cylindrical section 82. A stop surface in the form of a circular ledge 81 is located between the locking chamber 68 and the sealing chamber 70. As can best be seen in Figures 5 and 7, the lower wall segment is reinforced by external circumferentially spaced ribs 86 extending from ledge 80 to the body section 72. The lower ends 84 of external vertical ribs 86 lie on a plane demarcating the upper crown section 66 from the body section 72.

A tip mounting sequence will now be described with initial reference to Figure 8 where a pipette tip 26 is shown supported on the lower ends 84 of ribs 86 in the aperture of a support plate 88 or the like. The pipette 10 is first aligned with the tip 26 and then lowered, causing the cylindrical end 40 of the mounting shaft 24 to pass axially through the locking chamber 68 into the sealing chamber 70. The shoulder 32, aided by its chamfered leading edge 34, makes initial contact with the resilient fingers 76 and begins to deflect them outwardly.

Figure 9 shows an intermediate stage in the mounting sequence at which axial insertion of the mounting shaft 24 has progressed to the point where the resilient fingers 76 are now fully expanded, the O-ring seal 38 is about to enter into sealing engagement with the cylindrical section 82 of the sealing chamber 70, and the collar 60 has encountered the upper

rim 78 of the pipette tip and has begun to shift axially against the compressive force of spring 62 and away from the enlarged diameter end 56 of sleeve insert 54.

Figure 10 shows the final stage in the mounting sequence. As indicated by the arrows 90, the resilient fingers 76 have now snapped inwardly behind and in locked interengagement with the shoulder 32 on mounting shaft 24. Spring 62 has been compressed and loaded to an elevated level between shoulder 64 and collar 60. A fluid-tight seal has been established between the O-ring seal 38 and the cylindrical section 82 of the sealing chamber 70, and the shoulder 32 has bottomed out against the circular ledge 81. The ledge 81 thus establishes a positive stop, which in combination with the audible sound of the fingers 76 snapping into interlocked engagement, provides the user with a reliable indication that the pipette tip has been securely mounted. Because of the angle $\alpha$ of inward inclination of the interlocked fingers, any attempt to pull the pipette tip off of the mounting shaft 24 will only serve to further deflect the fingers inwardly, thus enhancing the interlocked relationship between the pipette tip and the cylinder extension.

With reference again to Figures 1 and 2, it will be seen that the pipette 10 further includes an ejection button 92 connected via a mechanical linkage (not shown) contained in housing 12 to a link 94 bearing against the spring retainer 50. Tip ejection is effected by manually pushing button 92 in the direction of arrow 96, resulting in a corresponding axial shifting of link 94, causing sleeve 44 to shift axially in the same direction on cylinder 24 against the compressive force of springs 46 and 62.

Figure 11 shows that as the sleeve 44 and its insert 54 shift in the direction of arrow 96, the resilient fingers 76 are biased outwardly by the enlarge diameter end 56 of insert 54. When the fingers are deflected outwardly beyond the shoulder 32, the axially interengaged relationship between the pipette tip 26 and the mounting shaft 24 is disrupted, allowing the spring 62, now loaded to an elevated level, to act via collar 60 to forcibly eject the tip 26 from the end of the mounting shaft. The spring loaded collar will also serve to forcibly eject

a pipette tip that has not been fully inserted, e.g., inserted only to the extent shown in Figure 9.

It thus will be seen that in order to effect tip ejection, a user need only press button 92 with a force necessary to overcome the resistance of springs 46 and 62. Appropriate spring selection will insure that this force is modest and ergonomically friendly.

In light of the foregoing, those skilled in the art will appreciate that the tip mounting and ejection assembly of the present invention is not limited in use to manually operable pipettes of the type herein disclosed, and that the concepts of the present invention are applicable to a wide range of mechanically and/or automatically driven pipette types and designs.

It should also be understood that various pipette tip designs may be employed with the above described mounting and ejection assembly. For example, in the tip embodiment shown at 26a in Figures 12A and 12B, although the upper section 66a of the tip again surrounds a locking chamber 68a, it is formed separately from and assembled as an insert into the upper end of the body section 72a. The resilient fingers 76a project in cantilever fashion upwardly from a circular base at the bottom of the locking chamber, and an internal shelf 98 has a through bore 100 surrounded by a raised bead 102 projecting upwardly into the locking chamber 68a. With this embodiment, the end surface 42 of the mounting shaft 24 will coact in sealing engagement with the raised bead 102, making it unnecessary to employ an O-ring seal 38.

In another pipette tip embodiment 26b shown in Figures 13A and 13B, the upper section 66b includes a locking chamber 68b and a lower sealing chamber 70b, and is again formed separately and assembled as an insert into the upper end of body section 72b. The resilient fingers 76b project downwardly and inwardly in cantilever fashion from a top rim into the locking chamber 68b, and the internal shelf 98b is located at the bottom of the upper section.

In Figures 14a and 14b, the pipette tip 26c is similar to that shown in Figures 13A and 13B, except that here the internal shelf 98c is formed as a thin apertured membrane designed to coact in sealing engagement with the end surface 42 of the mounting shaft 24.

In Figures 15A and 15B, the pipette tip 26d is similar to that depicted in Figures 4-7, except that here the sealing chamber 70c is bordered by an angled ledge 104 positioned to coact in sealing engagement with the O-ring seal 38 on the tubular shaft extension 24.

As shown in Figure 16, the O-ring 38 coacts in a "face sealing" relationship with the angled ledge 104, without disadvantageously increasing frictional resistance to subsequent ejection of the tip from the mounting shaft.

In light of the foregoing it will now be understood by those skilled in the art that the mounting shaft 24 of the pipette and each of the several pipette tip embodiments 26a-26d are respectively configured and dimensioned to effect an axially interengaged relationship and a snap connection between a shoulder 32 or the like on the former and resilient fingers on the crown sections of the latter. A positive stop on the pipette tip limits the extent of mounting shaft insertion required to achieve the snap connection, and this, together with the audible nature of the snap connection, provides the user with a reliable indication that an adequate insertion force has been exerted, and that the pipette tip has been reliably and securely retained on the mounting shaft.

Tip ejection requires only a modest force exerted on button 92 and transmitted to sleeve insert 54 to spread the resilient fingers 76 sufficiently to disrupt their interengaged relationship with the mounting shaft 24. The pipette tip is then freed for forcible ejection by the spring loaded collar 60.

We claim:

**The claims defining the invention are as follows:**

1. A pipette system, comprising:

a tubular pipette tip having an upper section surrounding a locking chamber, and a body section leading from said upper section and tapering downwardly to a reduced diameter end;

a tubular mounting shaft on said pipette, said mounting shaft having a distal end configured and dimensioned for axial insertion into said locking chamber;

coacting surfaces on the distal end of said mounting shaft and said upper section for establishing an axially interengaged relationship between said pipette tip and said mounting shaft in response to insertion of the distal end of said mounting shaft into said locking chamber; and

a sleeve movable relative to said mounting shaft between a retracted position accommodating the establishment of said axially interengaged relationship, and an advanced position disrupting said interengaged relationship to thereby accommodate axial ejection of said pipette tip from said mounting shaft;

wherein, in said advanced position, said sleeve is disposed between an inner surface of the upper section of said pipette tip and an outer surface of said tubular mounting shaft of said pipette so as to engage and deflect the inner surface of the pipette tip relative to the outer surface of the mounting shaft to eject said pipette tip.

2. The pipette system of claim 1 further comprising first spring means for exerting a first axial force urging said sleeve into said retracted position, and a mechanism for overcoming said first axial force to shift said sleeve from said retracted position to said advanced position.

3. The pipette system of claim 1 or 2 further comprising a collar axially shiftable on said sleeve between advanced and retracted positions, and second spring means for exerting a second axial force urging said collar into its advanced position, said collar being engagable by the upper section of said pipette tip during insertion of the distal end of said mounting shaft into said locking chamber, and being shifted against said second axial force from its advanced position to its retracted position during establishment of the axially interengaged relationship between said pipette tip and said mounting shaft, with the shifting of said collar from its advanced position to its retracted position being accompanied by an increase of said second force to an elevated level,

whereby upon disruption of said interengaged relationship, said second force at said elevated level operates to forcibly eject said pipette tip from said mounting shaft by returning said collar to its advanced position.

4. The pipette system of claim 1 wherein said coacting surfaces comprise at least one resilient finger on the upper section of said pipette tip, said finger being configured and arranged to project into said locking chamber and to snap inwardly into said interengaged relationship with an exterior shoulder on the distal end of said mounting shaft.

5. The pipette system of claim 4 wherein said sleeve is configured to disrupt said interengaged relationship by radially expanding said finger.

6. The pipette system of claim 4 wherein said pipette tip is provided with a stop surface coacting with said exterior shoulder to limit the extent of axial insertion of the distal end of said mounting shaft into said locking chamber.

7. The pipette system of claim 1 further comprising a resilient O-ring carried by the distal end of said mounting shaft, said O-ring being positioned to coact in sealing engagement with an interior of said upper section.

8. The pipette system of claim 7 wherein said upper section includes an upper wall segment surrounding said locking chamber, and a lower wall segment surrounding a sealing chamber, and wherein said O-ring is positioned to coact in sealing engagement with said lower wall segment.

9. The pipette system of claim 8 wherein said lower wall segment includes an entry section tapering inwardly and downwardly from said locking chamber to a cylindrical section leading to said body section, and wherein said O-ring is positioned to coact in sealing engagement with said cylindrical section.

10. A tubular pipette tip for use with a pipette having a mounting shaft defining a first interlocking surface, the pipette tip comprising:

an upper section surrounding a locking chamber;

a body section leading from said upper section and tapering downwardly to a reduced diameter end; and

a second interlocking surface on said upper section, said second interlocking surface being deflectable relative to said upper section and adapted to engage the first interlocking surface and to cooperate with the first interlocking surface such that said pipette tip is mechanically interlocked with the pipette when said pipette tip is received on the mounting shaft.

11. The pipette tip of claim 10 wherein said second interlocking surface is provided on a member that projects downwardly and inwardly from an upper rim of the upper section.

12. The pipette tip of claim 10 wherein a plurality of second interlocking surfaces are formed integrally with said upper section.

13. The pipette tip of any one of claims 10, 11 or 12 wherein said upper section and said body section are integrally molded as a single unit.

14. The pipette tip of any one of claims 10, 11 or 12 wherein said upper section and said body section are molded as separate units, and wherein said upper section is assembled as an insert into the upper end of said body section.

15. The pipette tip of claim 10 wherein said upper section includes an upper wall segment surrounding said locking chamber, and a lower wall segment surrounding a sealing chamber.

16. The pipette tip of claim 15 wherein said lower wall segment includes an entry section tapering inwardly and downwardly to a cylindrical section leading to said body section.

17. The pipette tip of claim 15 wherein said upper section includes a stop surface between said locking chamber and said sealing chamber.

18. The pipette tip of claim 17 wherein said stop surface comprises a circular ledge at the juncture of said upper and lower wall segments.

19. The pipette tip of claim 15 wherein said lower wall segment is provided with external circumferentially spaced vertical ribs.

20. The pipette tip of claim 18 wherein said lower wall segment is provided with external circumferentially spaced ribs extending from said circular ledge to said body section.

21. The pipette tip of claim 10 wherein said at least one second interlocking surface is provided on a member that projects upwardly and inwardly from the bottom of said locking chamber.

22. The pipette tip of claim 10 or 21 wherein said upper section includes an internal shelf at the bottom of said locking chamber, said shelf having a through bore.

23. The pipette tip of claim 22 wherein said through bore is surrounded by a raised bead projecting upwardly into said locking chamber.

24. The pipette tip of claim 10 wherein said upper section is provided with an internal chamfered surface bordering said locking chamber.

25. A pipette system, comprising:

a tubular pipette tip having an upper section surrounding a locking chamber, and a body section leading from said upper section and tapering downwardly to a reduced diameter end;

a tubular mounting shaft on said pipette, said mounting shaft having a distal end configured and dimensioned for axial insertion into said locking chamber;

coacting surfaces on the distal end of said mounting shaft and said upper section for establishing an axially interengaged relationship between said pipette tip and said mounting shaft in response to insertion of the distal end of said mounting shaft into said locking chamber, said coacting surfaces comprising a plurality of circumferentially spaced resilient fingers on the upper crown section of said pipette tip, said fingers being configured and arranged to project into said locking chamber and to snap inwardly into said interengaged relationship with an exterior surface on the distal end of said mounting shaft;

a sleeve movable relative to said mounting shaft between a retracted position accommodating the establishment of said axially interengaged relationship, and an advanced position disrupting said interengaged relationship to thereby accommodate axial ejection of said pipette tip from said mounting shaft;

first spring means for exerting a first axial force urging said sleeve into said retracted position;

a mechanism for overcoming said first axial force to shift said sleeve from said retracted position to said advanced position;

a collar axially shiftable on said sleeve between advanced and retracted positions; and

second spring means for exerting a second axial force urging said collar into its advanced position, said collar being engagable by the upper section of said pipette tip during insertion of the distal end of said mounting shaft into said locking chamber, and being shifted against said second axial force from its advanced position to its retracted position during establishment of the axially interengaged relationship between said pipette tip and said mounting shaft, with the shifting of said collar from its advanced position to its retracted position being accompanied by an increase of said second force to an elevated level, whereby upon disruption of said interengaged relationship, said second force at said elevated level operates to forcibly eject said pipette tip from said mounting shaft by returning said collar to its advanced position.

26. A liquid handling system, comprising:

a tubular tip having an upper section and a body section leading from said upper section;

a tubular mounting shaft on said liquid handling system, said mounting shaft having a distal end configured to engage said upper section;

coacting surfaces on the distal end of said mounting shaft and said upper section for establishing an interengaged relationship between said tip and said mounting shaft; and

a sleeve movable relative to said mounting shaft between a retracted position accommodating the establishment of said interengaged relationship, and an advanced position for disrupting said interengaged relationship to thereby accommodate axial ejection of said tip from said mounting shaft;

wherein, in said advanced position, said sleeve is disposed between an inner surface of the upper section of said pipette tip and an outer surface of said tubular

mounting shaft of said pipette so as to engage and deflect the inner surface of the pipette tip relative to the outer surface of the mounting shaft to eject said pipette tip.

27. The liquid handling system of claim 26 further comprising a first resilient device for exerting a first axial force urging said sleeve into said retracted position, and a mechanism for overcoming said first axial force to shift said sleeve from said retracted position to said advanced position.

28. The liquid handling system of claim 27 further comprising a collar movable relative to said sleeve between advanced and retracted positions, and a second resilient device for exerting a second axial force urging said collar into its advanced position, said collar being engagable by the upper section of said tip during engagement of the distal end of said mounting shaft with said upper section, and being shifted against said second axial force from its advanced position to its retracted position during establishment of the interengaged relationship between said tip and said mounting shaft, with the shifting of said collar from its advanced position to its retracted position being accompanied by an increase of said second force to an elevated level, whereby upon disruption of said interengaged relationship, said second force at said elevated level operates to forcibly eject said tip from said mounting shaft by returning said collar to its advanced position.

29. The liquid handling system of claim 26 wherein said coacting surfaces comprise at least one resilient member on the upper section of said tip, said member being configured and arranged to snap into said interengaged relationship with the distal end of said mounting shaft.

30. The liquid handling system of claim 29 wherein said sleeve is configured to disrupt said interengaged relationship by radially expanding said member.

31. The liquid handling system of claim 29 wherein said tip is provided with a stop surface coacting with the distal end of said mounting shaft.

32. The liquid handling system of claim 26 further comprising a resilient O-ring carried by the distal end of said mounting shaft, said O-ring being positioned to coact in sealing engagement with said upper section.

33. The liquid handling system of claim 32 wherein said upper section includes an upper wall segment surrounding a locking chamber, and a lower wall segment surrounding a sealing chamber, and wherein said O-ring is positioned to coact in sealing engagement with said lower wall segment.

34. The liquid handling system of claim 33 wherein said lower wall segment includes an entry section tapering inwardly and downwardly from said locking chamber to a cylindrical section leading to said body section, and wherein said O-ring is positioned to coact in sealing engagement with said cylindrical section.

35. A pipette system, comprising:

a pipette including a mounting shaft;

a pipette tip configured to be received on said mounting shaft;

first locking structure on said mounting shaft;

second locking structure on said pipette tip;

said first and second locking structures cooperating when engaged to mechanically lock said pipette tip against axial movement along said mounting shaft;

said second locking structure being movable from a first position wherein said pipette tip is mechanically locked with said mounting shaft, to a second position wherein said first and second locking structure are disengaged; and

a sleeve movable relative to said mounting shaft to engage and move said second locking structure from said first position to said second position when said sleeve is disposed between an inner surface of the second locking structure of said pipette tip and an outer surface of the first locking structure of said mounting shaft of said pipette.

**Dated 7 July, 2010**

**Matrix Technologies Corporation**

**Patent Attorneys for the Applicant/Nominated Person**

**SPRUSON & FERGUSON**

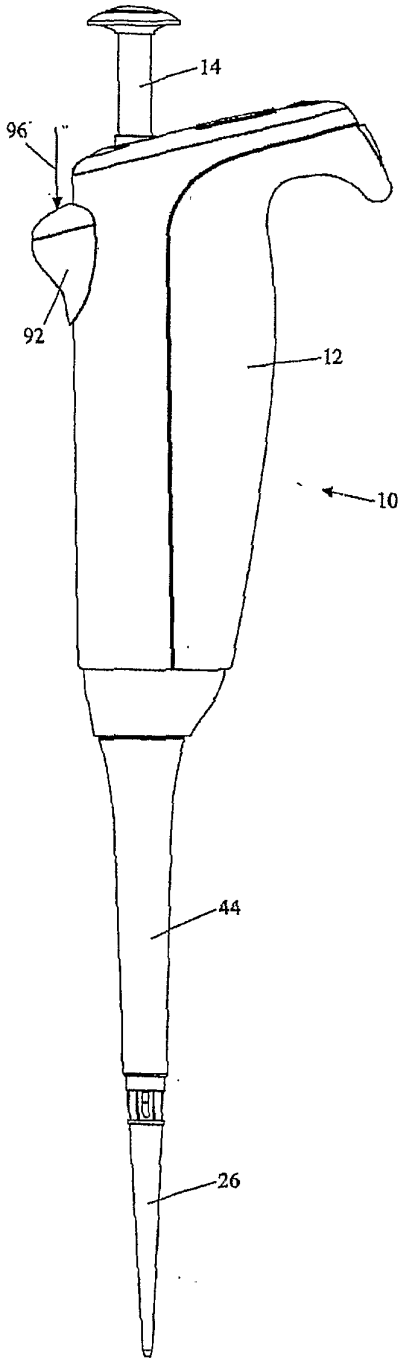


FIG. 1

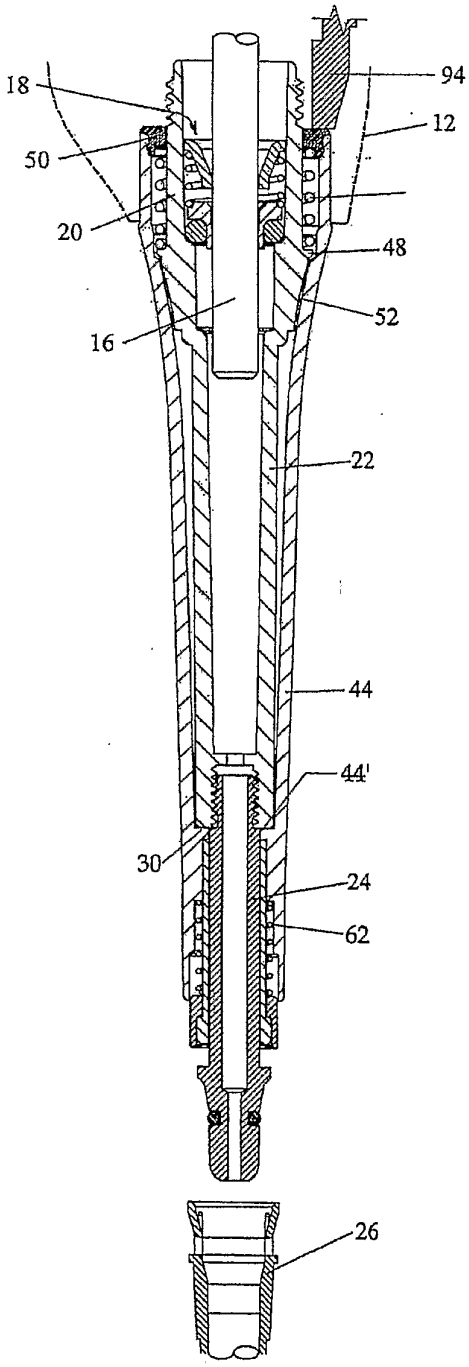
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FIG. 2

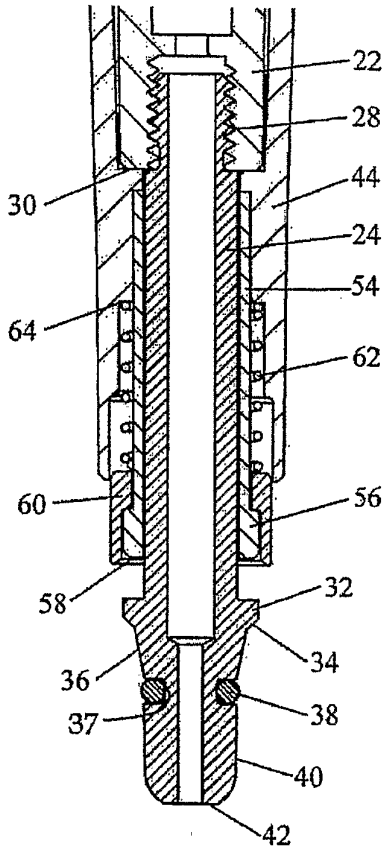
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FIG. 3

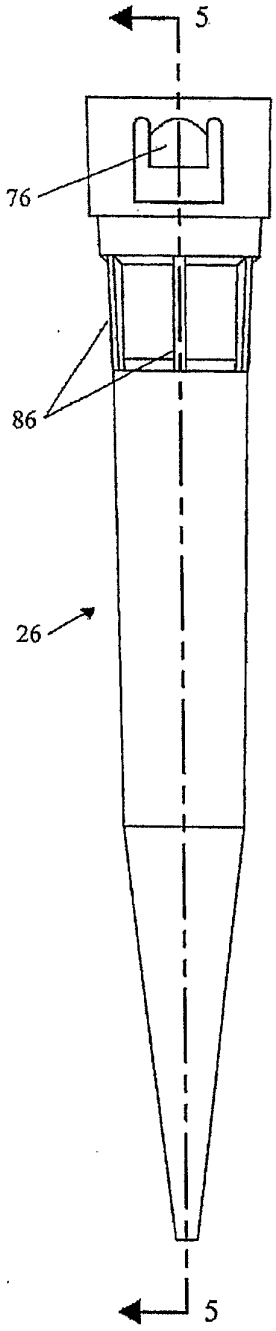


FIG. 4

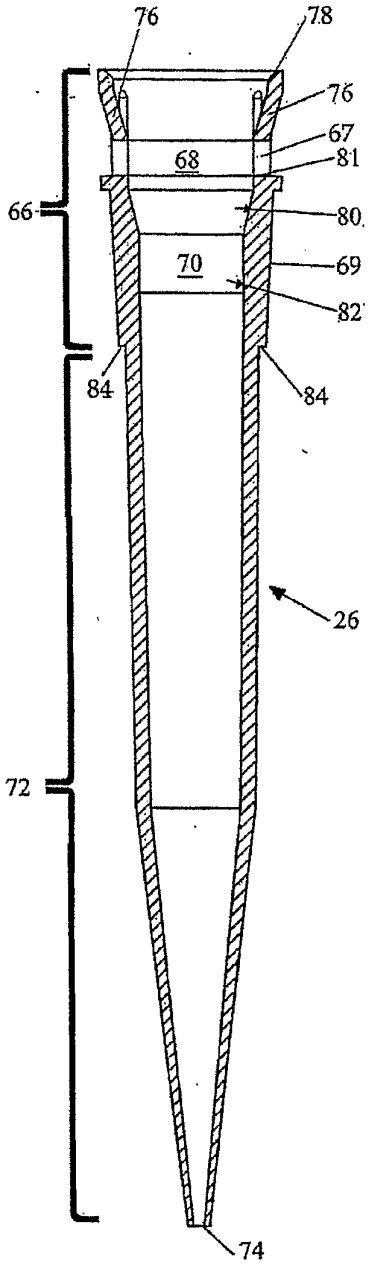


FIG. 5

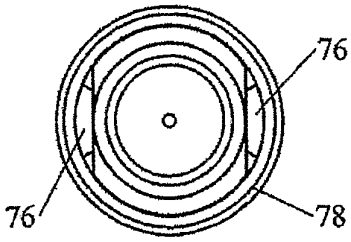


FIG. 6

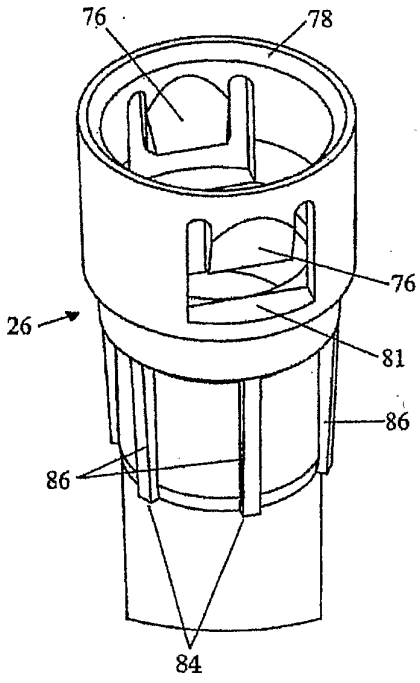


FIG. 7

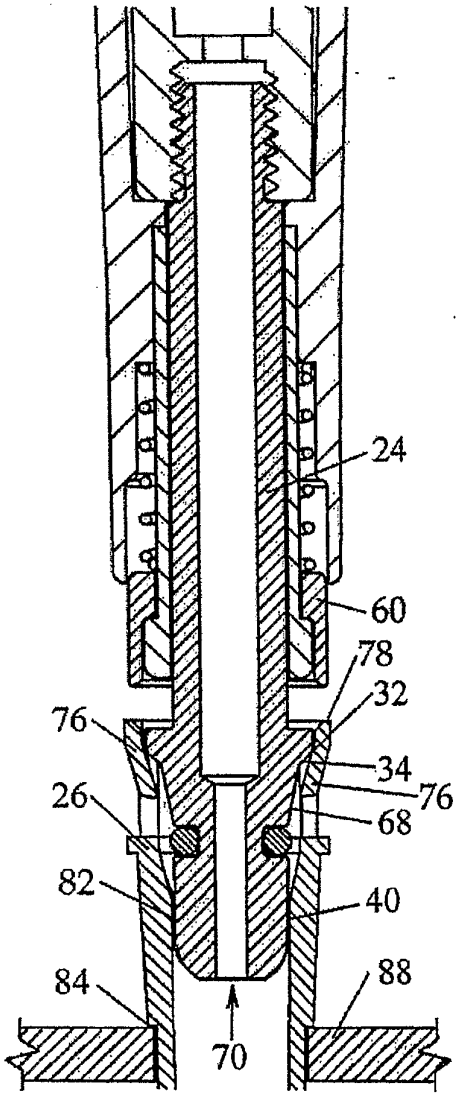
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FIG. 8

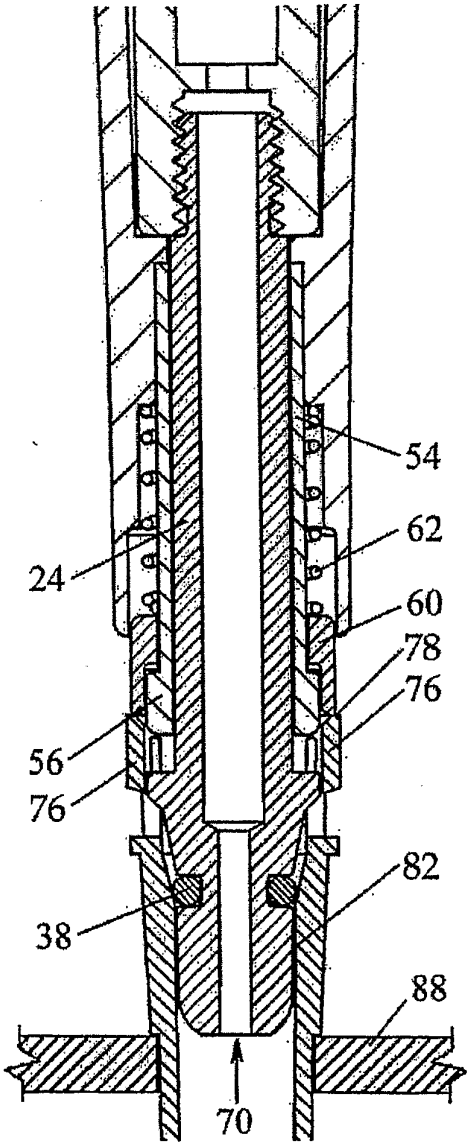
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FIG. 9

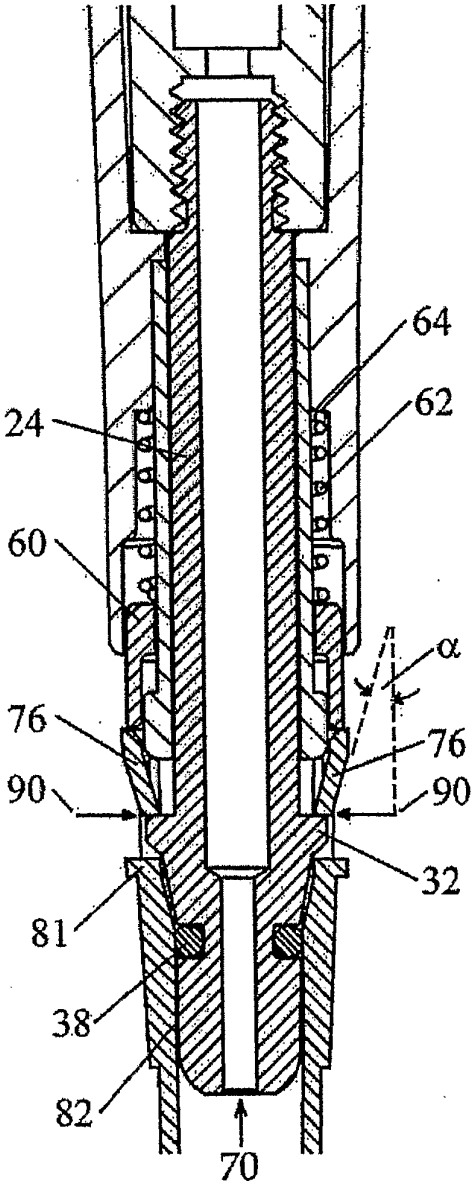


FIG. 10

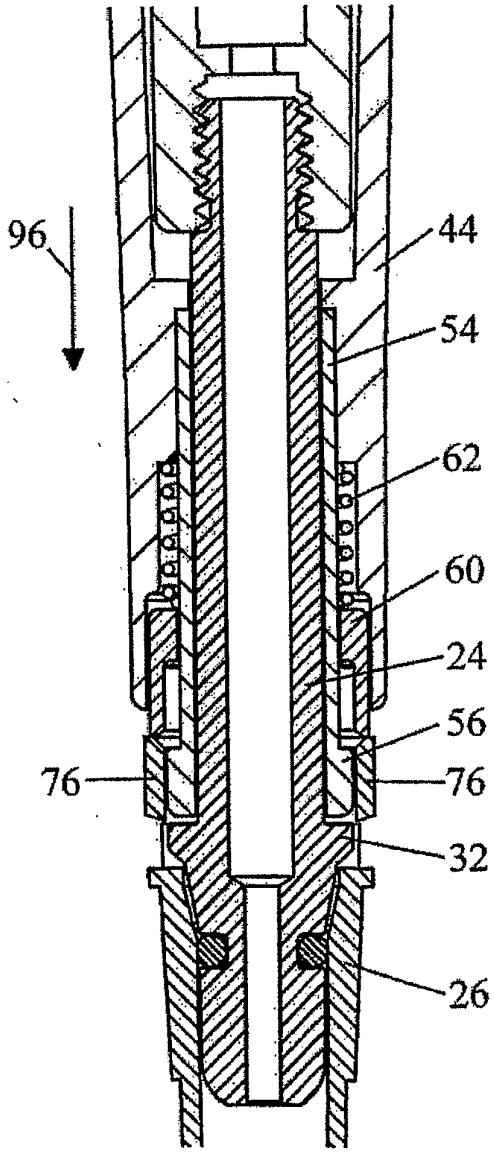


FIG. 11

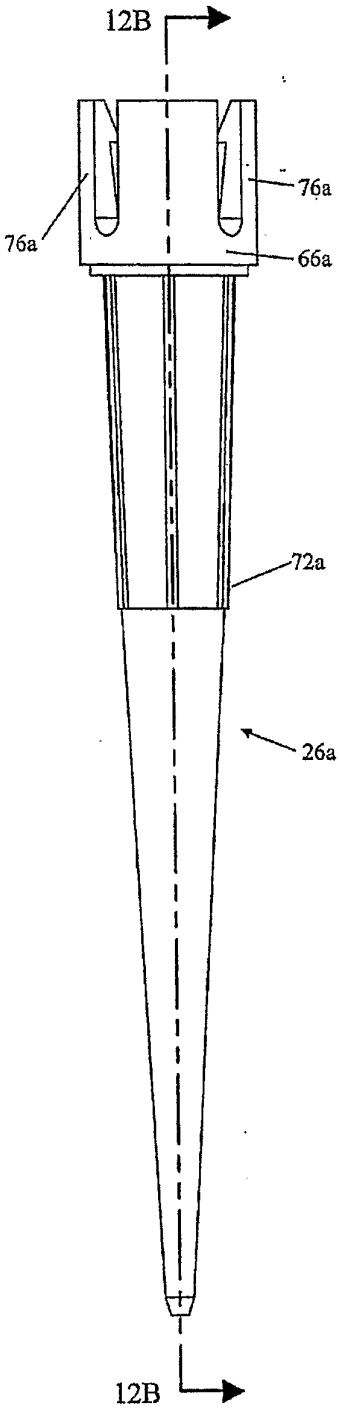


FIG. 12A

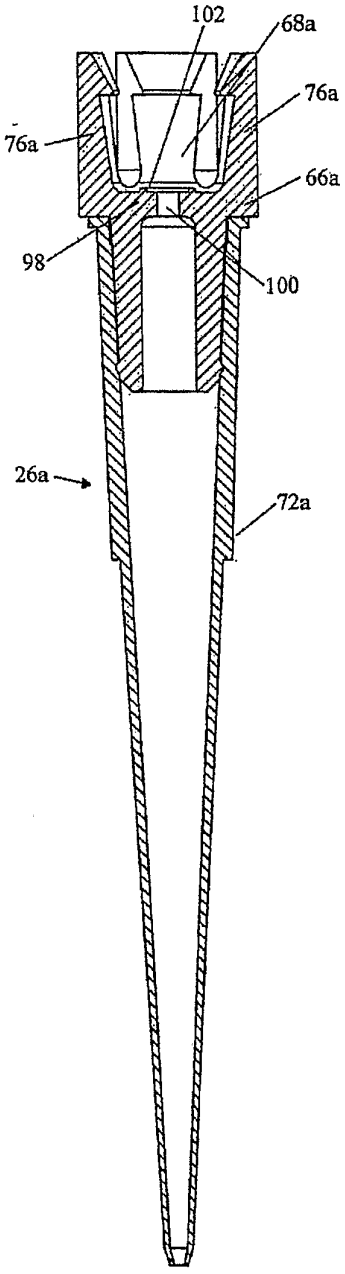


FIG. 12B

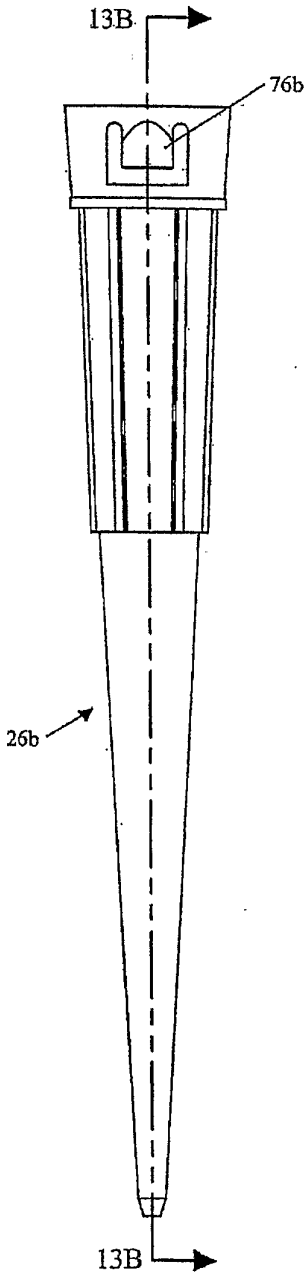


FIG. 13A

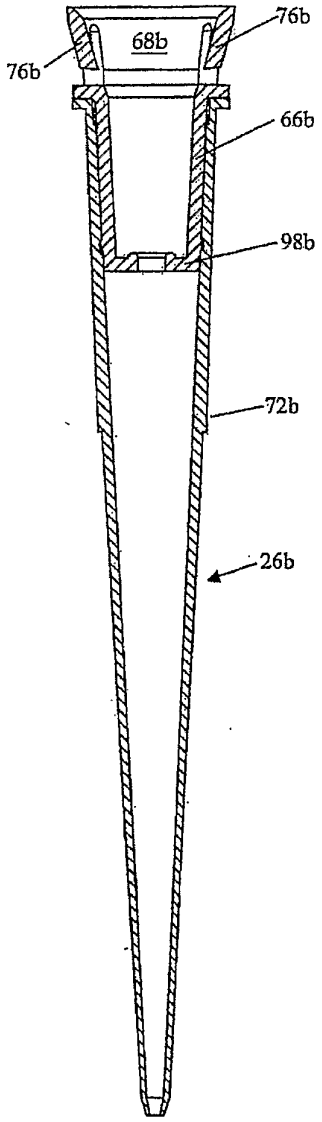


FIG. 13B

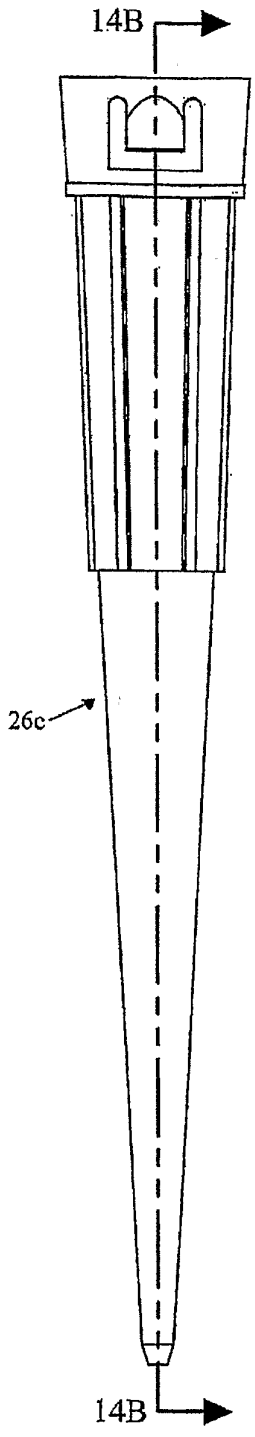


FIG. 14A

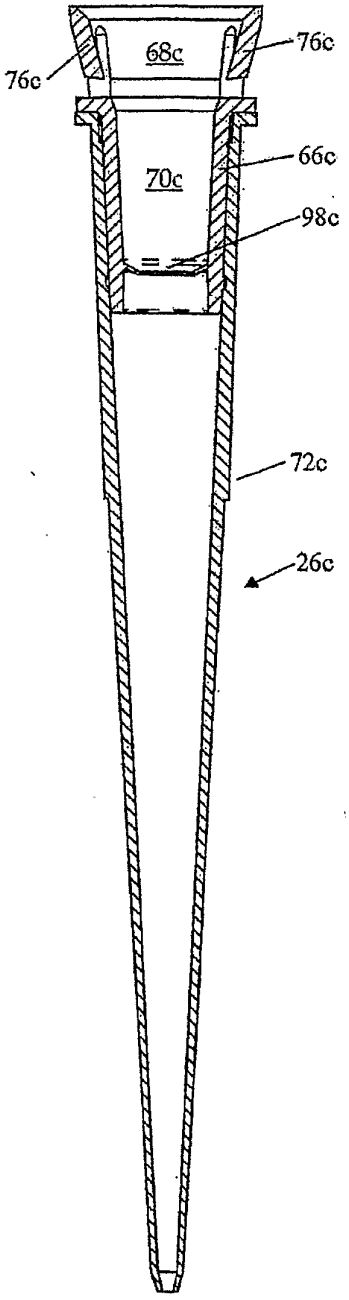


FIG. 14B

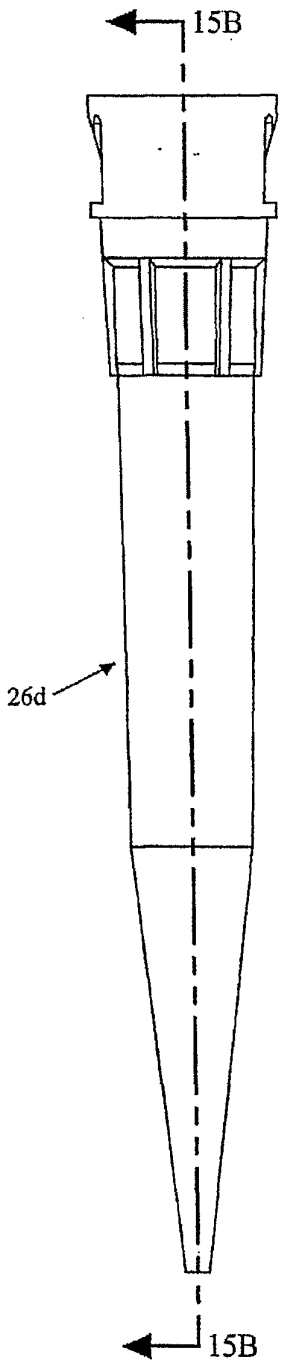


FIG.15A

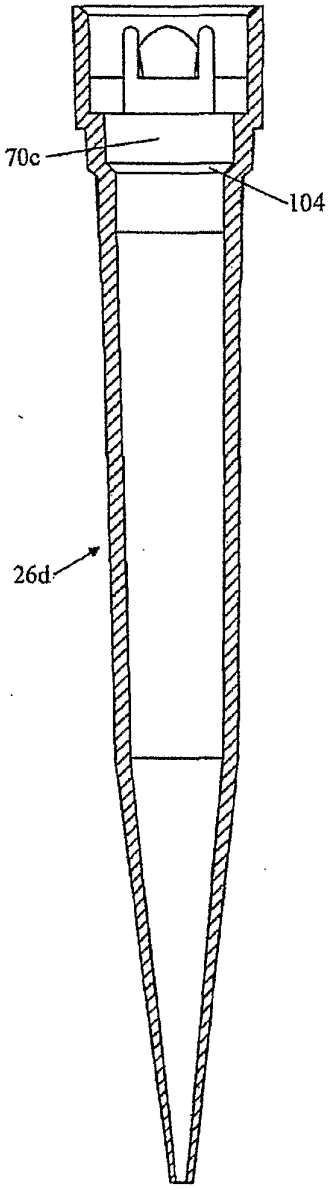


FIG. 15B

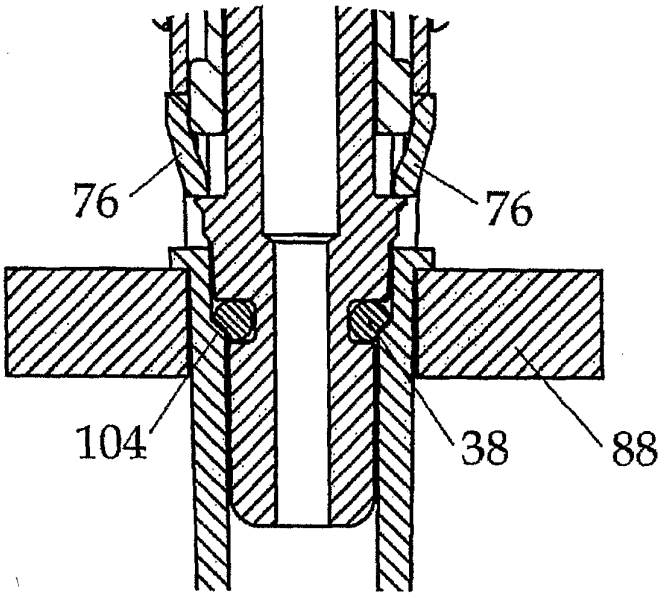


FIG. 16