

Nov. 15, 1966

KENZO ISHIMARU ETAL

3,285,296

PIPETTE APPARATUS

Filed April 24, 1964

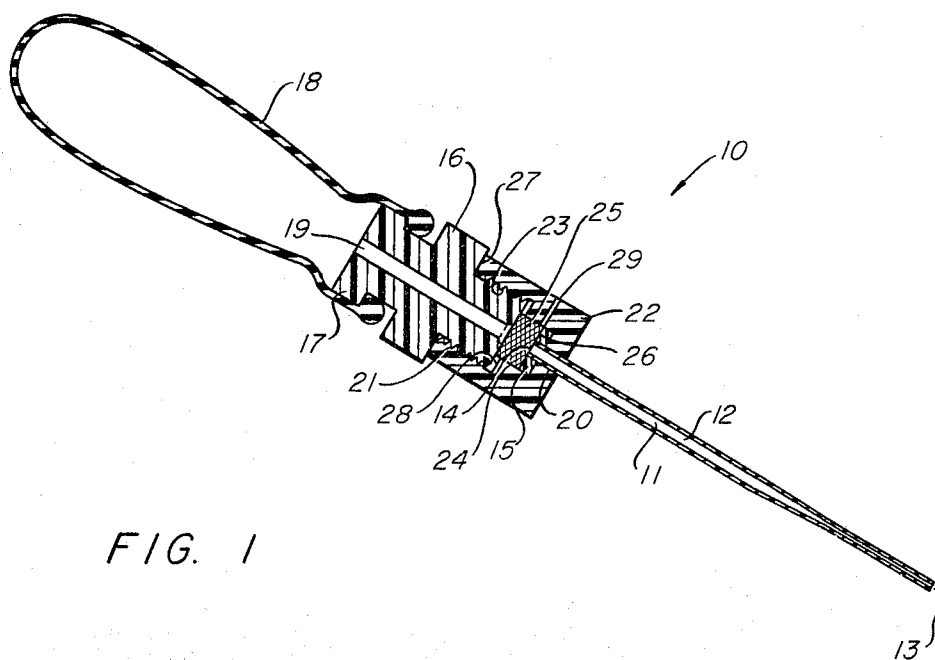


FIG. 1

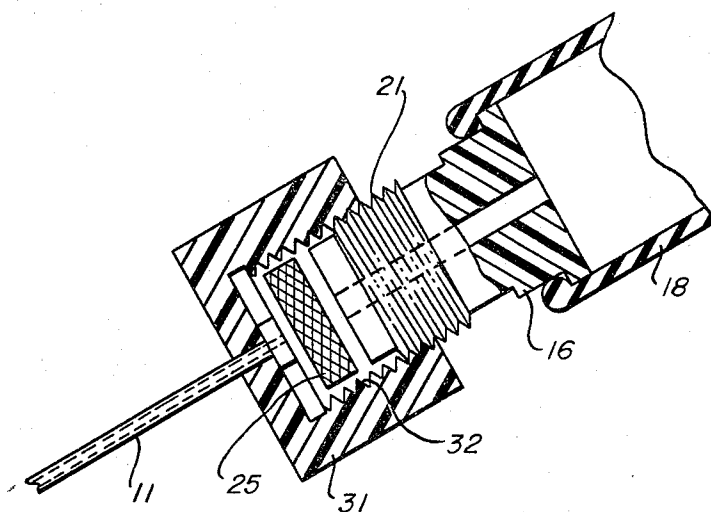


FIG. 2

INVENTORS

KENZO ISHIMARU

BY ROBERT C. MYERS

Flehrs and Swain
ATTORNEYS

1

3,285,296

PIPETTE APPARATUS

Kenzo Ishimaru and Robert C. Myers, San Jose, Calif.,
assignors to Beckman Instruments, Inc., a corporation
of California

Filed Apr. 24, 1964, Ser. No. 362,217

6 Claims. (Cl. 141-26)

This invention relates to pipette apparatus for measuring and dispensing precise volumes of fluid, and is particularly useful in handling aqueous solutions.

Various types of pipette apparatus have been employed to measure and dispense precise volumes of fluid. One type of such apparatus employs a pipette element supported by a squeeze bottle and includes valving means for controlling the application of pressure or suction to the pipette element. Manipulation of certain of these devices has required some degree of dexterity on the part of the operator.

It is a general object of the present invention to provide an improved pipette apparatus requiring a minimum of operator dexterity.

Another object of the invention is to provide improved pipette apparatus incorporating simplified valve means therein.

Still another object of the invention is to provide pipette apparatus of minimum bulk and of simplified construction.

A further object of the invention is the provision of an improved method of handling and manipulating precise volumes of fluids utilizing a pipette.

These and other objects of the invention will be more clearly apparent from the following detailed description of a preferred embodiment when taken with the accompanying drawings in which:

FIGURE 1 shows a side elevation centerline section view of a pipette apparatus according to the invention; and,

FIGURE 2 shows a side elevation centerline section view of a simplified embodiment of the invention.

In general, there is provided pipette apparatus employing an elongated pipette element. One end of the pipette element serves to transfer fluid between the hollow bore of the element and the outside surroundings. The element is mounted or supported from the other end. The hollow bore defines a precise predetermined volume of liquid to be handled by the pipette element. Means are provided for selectively applying either a modest positive or negative pressure to the bore of the element at the mounting end so as to either expel or draw liquid into the bore via the fluid transfer end.

In order to limit the intake of liquid into the bore to the precise volume defined by the bore, while retaining the ability to expel liquid from the bore by application of air pressure thereto, there is provided a valve member, of a semipermeable material which is impervious to liquid and pervious to gas. This member is disposed to block the bore at the mounting end thereof. The means for selectively applying pressure or suction to the bore is arranged to direct a flow of air through the blocking valve member. Thus, when suction is applied to the mounting end of the pipette through the blocking member, liquid will enter the pipette at the transfer end and proceed until contact is made with the blocking member. At that point the impervious nature of the member serves to limit the further intake of liquid.

In FIGURE 1 the pipette apparatus 10 includes a pipette element 11. Element 11 is formed with an elongated hollow bore 12 of suitable diameter. For handling micro volumes, the bore diameter can suitably be on the order of one or two sixteenths of an inch. The outer

2

end 13 of element 11 is of sufficiently small diameter to form a meniscus therein to retain the volume of liquid within bore 12. The other end 14 is formed with a flange portion 15 for mounting pipette element 11 in an operating position.

Means for selectively applying either negative or positive pressure to bore 12 at the mounting end of element 11 includes an elongated body member 16 provided with a flange 17 at one end for retaining a resilient squeeze bulb 18. Positive and negative pressure is, of course, relative to atmospheric pressure of the outside surroundings. Body member 16 is provided with an air passage 19 providing communication between squeeze bulb 18 and a valve member 25 to provide positive or negative pressure to the pipette element through pervious valve member 25. The other end of body member 16 includes a threaded portion 21 adapted to receive a retaining cap 22.

The end of cap 22 includes a drilled hole 20 slightly larger than the outer diameter of pipette element 11 whereby element 11 can be passed through same and retained by flange 15 formed therein.

Cap 22 is formed with a first annular opening 23 provided with threads on the side wall to receive the threaded end of body member 16. Coaxially of opening 23 an annular recess 24 is formed in the end of cap 22 to receive a valve member 25 seated therein.

Valve member 25 is formed of a semipermeable material pervious to gas and impervious to liquid. "Non-wettable" materials can provide this characteristic as in "expanded" or foam form. The material is also resilient to permit compression thereof and has a sponge-like porous texture providing gas passages or pores through the material but which are impervious to liquid. One suitable material for this purpose is expanded Teflon. The material marketed under the trademark Teflon is manufactured by E. I. du Pont de Nemours and Company of Wilmington, Delaware. It has been described as a plastic consisting of a tetrafluoroethylene polymer. It is characterized by outstanding chemical resistance, excellent electrical properties and good heat stability. In thin sections it is transparent, but in thicker pieces it appears waxy, and white or gray in color. Other membranous materials can be used.

Member 25 is formed with a flat face 26 adapted to abut and seal the flat face of flange 15 when pressed against same.

Means are provided which serve to limit the amount of compression applied to member 25 as body member 16 is screwed fully into cap 22. Thus, the annular collar 27 forms a seat which contacts the end of cap member 22 when body member 16 is fully inserted into opening 23. The axial extent to which member 25 protrudes beyond face 28 is sufficient to press and retain member 25 in place while preserving gas pervious pores through member 25.

A vent 29 communicates from the outside surroundings to the region of recess 24 through the side wall of recess 24 to provide "breathing" with respect to squeeze bulb 18. Thus, bulb 18 breathes through a path extending radially through member 25. Vent 29, which is preferably on the order of a sixteenth of an inch, therefore always serves to provide an air bypass passage between the outside surroundings and squeeze bulb 18 whereby air can reach the interior of squeeze bulb 18 and permit relaxation of same notwithstanding the presence of liquid within the bore of pipette element 11.

During compression of bulb 18, the impedance to air flow along a path leading to vent 29 is appreciably greater than along a flow path leading to the pipette contents, so as to expel the contents.

3

This increased impedance can be preferably provided by locating vent 29 in the side wall of recess 24. Axial alignment of air passage 19 and bore 12 relieves to some extent the compressive force applied by the end face of body member 16. Thus, the pores axially through valve member 25 are less constricted than the pores radially spaced from the axis of member 25. Greater flow path impedance is provided, also, by the longer path of air flow from the end of passage 19 to vent 29 than to end 14 of bore 12. If additional impedance is desired vent 29 can be of smaller cross-section than the opening formed at the discharge end 13 of pipette 11.

Manipulation and handling of a precise volume of liquid using pipette element 11 follows the steps of compressing the squeeze bulb 18 and then disposing the transfer end of element 11 into liquid to be handled. The semi-permeable material of member 25 is held in position to close the other end of bore 12. Suction is applied at the mounting end of bore 12 through the material of member 25 by releasing bulb 18 to draw liquid into bore 12 until incoming liquid contacts the non-wettable semipermeable material. Thus, the bore is loaded with a volume of liquid and then, while retaining the material of member 25 in capping relation to the bore, gas pressure is applied through the material by compressing squeeze bulb 18 to expel liquid from bore 12 at any desired station or destination.

A further simplified embodiment of the pipette apparatus disclosed above is shown in FIGURE 2 wherein substantially the same body member 16, squeeze bulb 18, pipette element 11, and valve member 25 have been employed with a retaining cap 31 having but a single recess 32 formed therein. Recess 32 is threaded to receive the threads 21 of body member 16. However, the threads of recess 32 provide something of a loose fit with threads 21 and thereby provide breathing between the interior of squeeze bulb 18 and the outside surroundings.

In the embodiment shown in FIGURE 2 the degree of perviousness of member 25 is fully controllable from a compressed condition whereby no air can pass through its pores to a maximum perviousness whereby the pores through member 25 are fully open for air passage. Thus, it can be seen in the embodiment of FIGURE 2 that after filling bore 12 of element 11, body member 16 can be screwed tightly against member 25 and thereby close the pores of member 25 to "lock" the contents within bore 12. Thus, the contents are protected against the possibility of accidental or inadvertent delivery thereof.

It will be evident from the foregoing that to control the operation of the apparatus no manipulation, other than squeezing and release of the bulb 18, is required.

What is claimed is:

1. Pipette apparatus comprising an elongated pipette element having a fluid transfer end, a mounting end, and a hollow bore therebetween to define a predetermined volume of liquid therein, a resilient squeeze bulb at said mounting end for selectively supplying either positive or negative pressure to the bore at the mounting end of the element to respectively expel or draw liquid into the

4

bore via the fluid transfer end, a semi-permeable member, impervious to liquid and pervious to gas, disposed to block the bore at the mounting end of said pipette element to limit the further intake of liquid while permitting liquid to be expelled from the bore by applying air under pressure thereto by said squeeze bulb, and means forming an air vent connecting the interior of the squeeze bulb to the outside surroundings via said member to automatically relieve vacuum within the squeeze bulb and to permit such bulb to return to a relaxed position following release thereof.

2. Pipette apparatus according to claim 1 wherein said member is resilient and disposed to be partially compressed against the mounting end of the pipette element, and means serving to limit the compression to preserve gas pervious pores through said member.

3. Pipette apparatus according to claim 1 wherein said member is resilient and disposed to be compressed against the mounting end of the pipette element to selectively fully close or fully open the semi-permeable pores thereof to control the gas pervious condition of said member.

4. In pipette apparatus having an elongated hollow element of predetermined length defining between the ends thereof a volume of liquid to be dispensed, having a support member to carry the element from one end of the element, the other end being free to transfer liquid therethrough, and further having a deformable resilient bulb for applying pressure or suction to the element at the supported end serving to expel the contents of the element or draw liquid into same, the improvement comprising a semi-permeable valve member pervious to air and impervious to liquid disposed to cap the mounting end of the bore and transmit air under either pressure or suction therethrough along a first path as applied by the bulb, a breather vent disposed to pass air between the outside surroundings and the bulb through said valve member along a second path, said second path providing substantially greater impedance to air flow therealong than along said first path.

5. Pipette apparatus according to claim 4 wherein said second path is longer than said first path.

6. Pipette apparatus according to claim 4 wherein each path includes a portion extending through the valve member, that portion of the second path which extends through said valve member being under greater compression than that portion of the first path which extends through the valve member to provide greater constriction of the air passages along said second path.

References Cited by the Examiner

UNITED STATES PATENTS

813,256	4/1905	Takaki	73—425.6 X
2,634,028	4/1953	Brown	222—189
3,039,500	6/1962	Goldberg	141—26
3,197,946	8/1965	Taylor	55—527 X

LAVERNE D. GEIGER, *Primary Examiner*.

H. BELL, *Assistant Examiner*.