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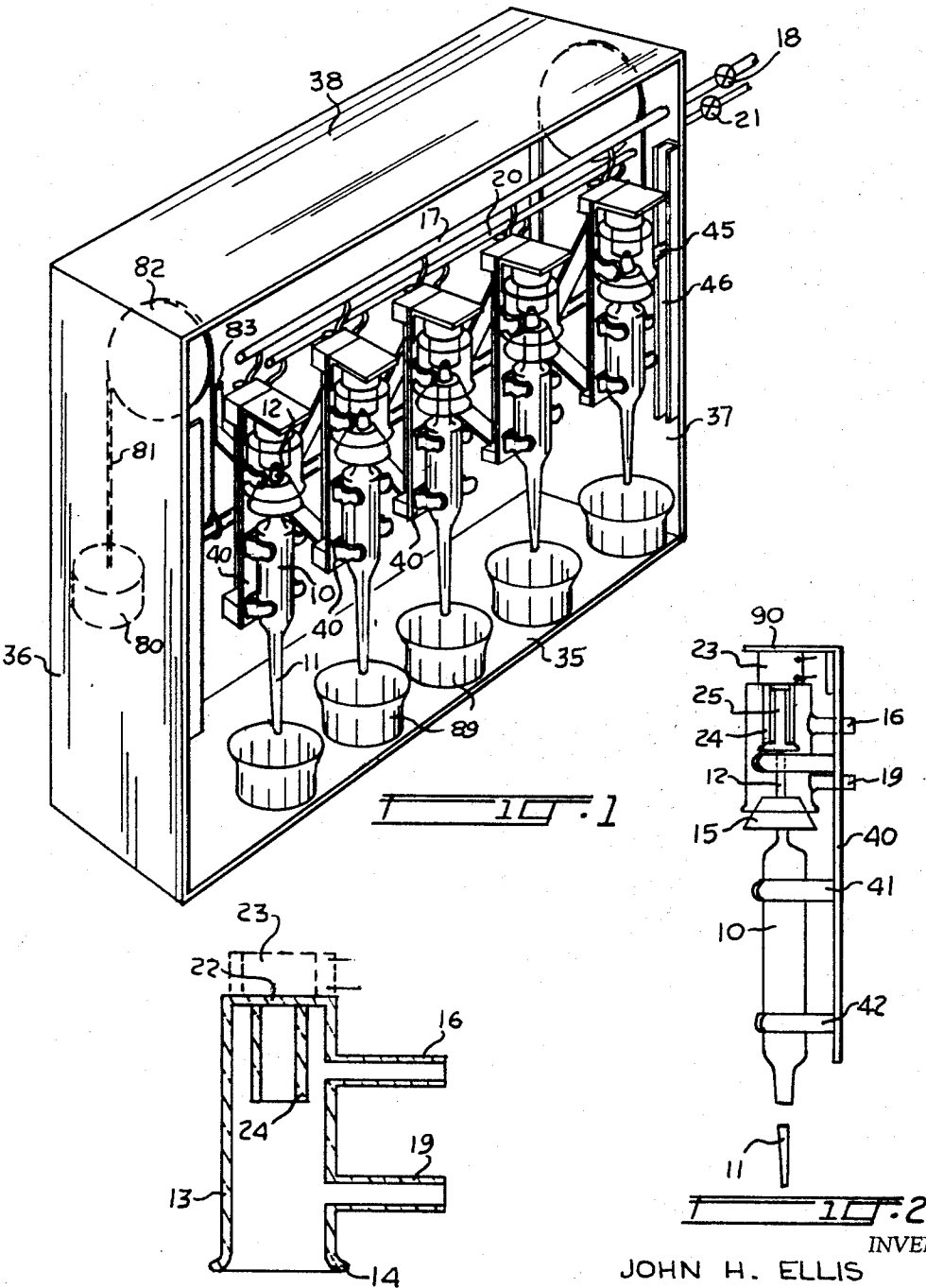
J. H. ELLIS ET AL

3,444,742

MULTIPLE-UNIT PIPETTING ASSEMBLY AND PIPETTE FOR USE THEREIN

Filed Dec. 6, 1965

Sheet 1 of 3



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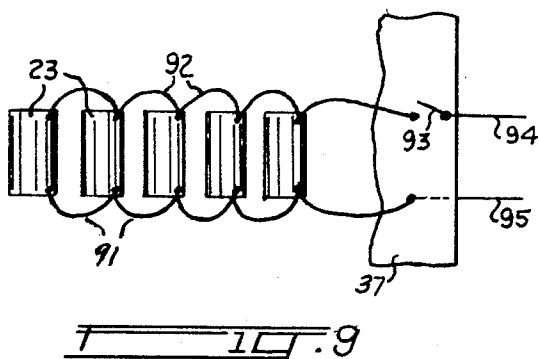
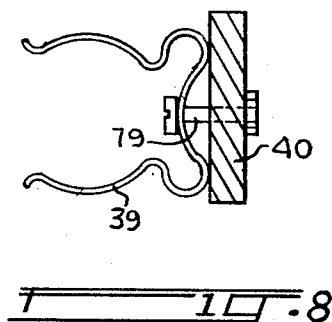
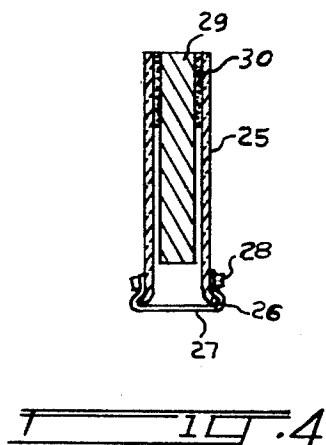
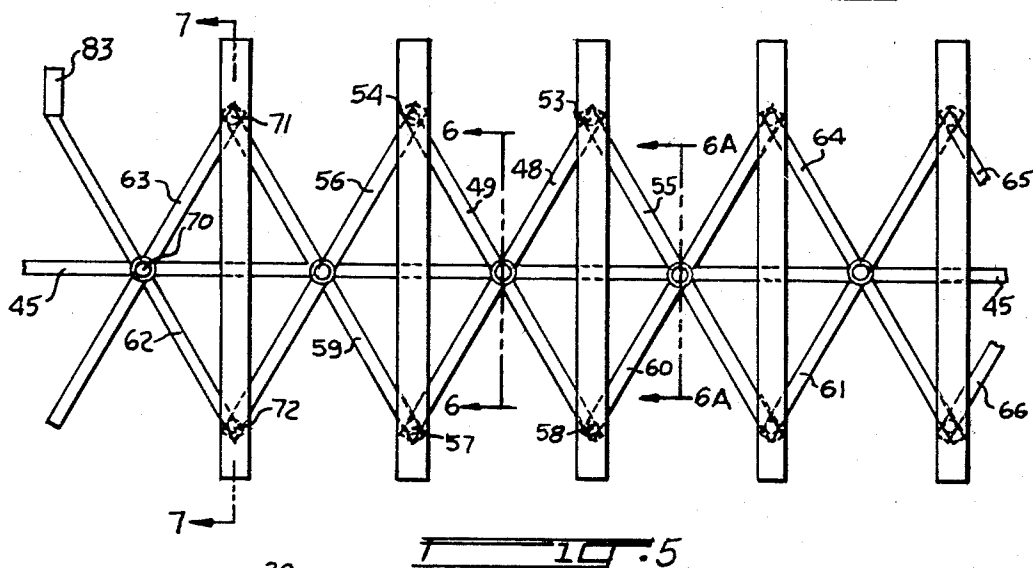
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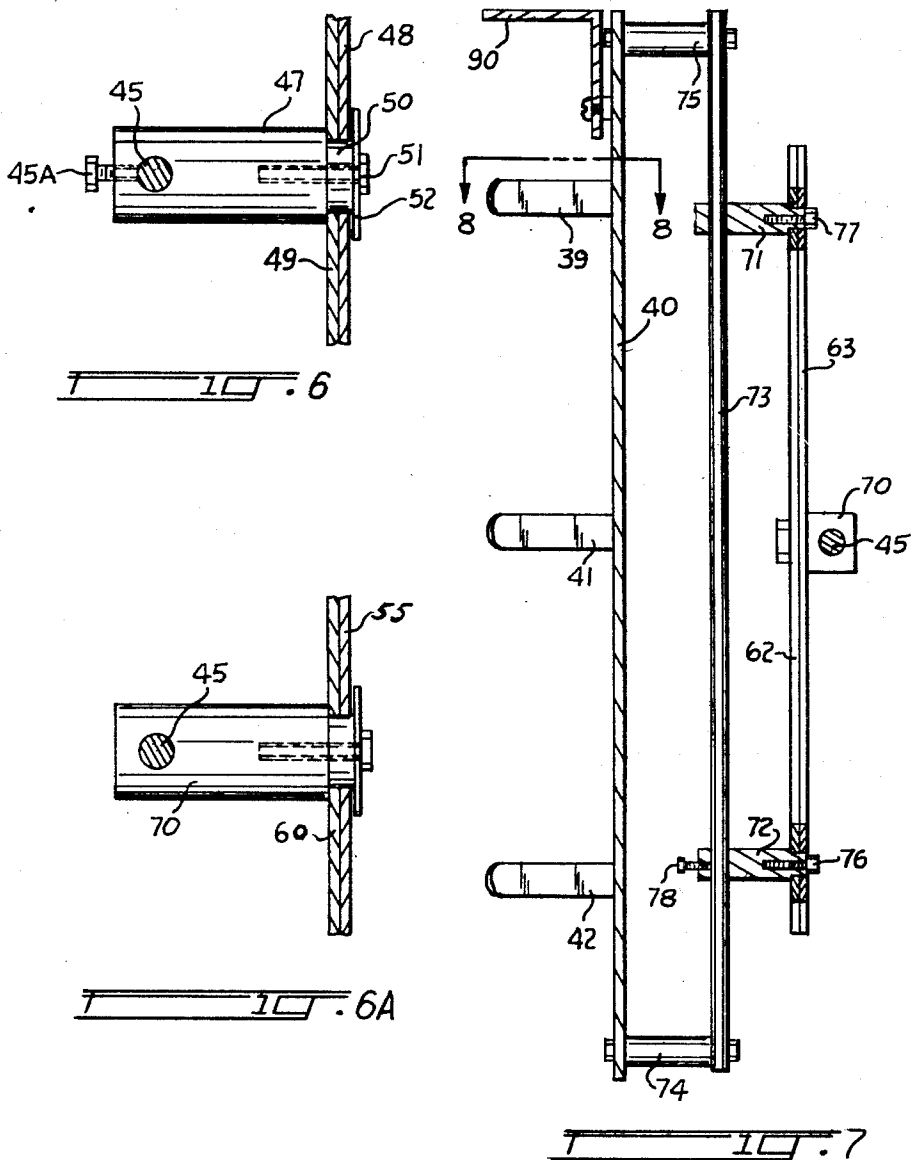
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MULTIPLE-UNIT PIPETTING ASSEMBLY AND PIPETTE FOR USE THEREIN

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3 Claims 10

ABSTRACT OF THE DISCLOSURE

A frame supported pipette includes a cap member having suction and pressure conduits leading thereto and having a magnetically controlled valve for permitting filling and emptying of the pipette; a battery of pipettes adjustable for use with different lateral spacings between the respective pipettes is disclosed.

This invention relates to chemical laboratory apparatus and more particularly to an improved multi-unit pipetting assembly and to a pipette for use therein.

The employment of pipettes which are required to dispense an accurate fixed volume of liquid often necessitates careful manipulation by the operator and a resulting slowing of the output of his work. When the type of analysis being conducted involves the simultaneous use of a battery of pipettes, the seals on each pipette must be carefully watched lest one or more of the pipettes handle a non-uniform volume, or lest an unnecessary wastage of overflow liquid takes place. Moreover, when valve means positioned in the pipette itself are employed, the chances or drippage or other factors involving the dispensing of non-uniform volumes are enhanced. Furthermore, a multi-unit pipetting apparatus should be adaptable for cooperation with beaker arrays which have different lateral spacings and the resulting adjustments of the pipetting apparatus should not adversely affect its seals, its accuracy, or its capabilities for rapid manipulations. It, therefore, is a purpose of the present invention to provide an improved pipetting apparatus capable of satisfying such requirements while at the same time overcoming limitations of the enumerated type as now found in conventional apparatus.

An object of the invention is to provide an improved fixed volume pipette having a selectively controlled valve effecting a reinforcing seal.

Another object is to provide a multi-unit pipetting assembly characterized by its ease of manipulation and its adaptability to use with associated equipment.

These and other objects and advantages of the invention will become more apparent as the description proceeds and when considered in conjunction with the accompanying drawings in which,

FIG. 1 is a perspective view of one form of multi-unit pipetting apparatus employing the invention.

FIG. 2 is a side elevation view of a single pipette assembled upon a supporting plate.

FIG. 3 is a longitudinal sectional view through the hollow capping chamber drawn to a larger scale and with the associated solenoid coil indicated by dotted lines.

FIG. 4 is a longitudinal sectional view through the magnetically controlled valve drawn to a larger scale.

FIG. 5 is a diagrammatic view indicating a mounting means for laterally adjusting the positions of a plurality of pipettes.

FIG. 6 is a view partly in section taken on line 6—6 of FIG. 5 to a larger scale and showing the fixed hub of the lateral spacing means.

FIG. 6A is a view similar to FIG. 6 and taken on line 6A—6A of FIG. 5.

FIG. 7 is a side elevation view to a larger scale and showing the mounting for a pipette supporting plate as indicated at line 7—7 of FIG. 5.

FIG. 8 is a sectional view taken on line 8—8 of FIG. 7, and

FIG. 9 is a schematic wiring diagram for the coils of a plurality of pipettes assembled as indicated by FIG. 1.

Referring now to FIGS. 2, 3 and 4, a pipette of the fixed volume type is disclosed therein and comprising a glass main body 10 having an open lower stem 11 and an open upper stem 12 integrally formed therewith. A passage preferably of capillary dimensions extends through these stems, and the extreme upper end of the upper stem has a smooth rim about its opening which is arranged in a plane normal to the axis of that stem. For use with the pipette there is provided a hollow capping chamber preferably of transparent material such as glass and having a generally cylindrical body portion 13 with an outwardly flared lower lip 14 adapted to form a tight fit with a truncated conical seal 15 which includes a central opening forming a tight seal with the exterior of the upper stem 12 as best shown in FIG. 2. Projecting laterally from the chamber is an upper conduit 16 adapted for connection to a flexible tubing connected to a manifold 17 leading to a source of gas under super-atmospheric pressure and controlled by any suitable valve means 18 (FIG. 1). Also projecting laterally from the chamber at a location below the upper end of stem 12 is a lower conduit 19 serving to drain liquid from the chamber and adapted for connection to a flexible tubing connected to a manifold 20 leading to a disposal point and controlled by a suitable valve means 21.

The upper end of a chamber 13 is closed as at 22 by a suitable cover on which a solenoid coil 23, later to be described, is adapted to rest. Extending downwardly from the cover and terminating above the conduit 19 is an interior tube 24 serving as a guide for the hollow valve stem 25 (FIG. 4) of an improved magnetically controlled valve. This valve stem preferably is formed of glass and has an outwardly flared lip 26 at its lower end. Covering the lower end of the valve stem is an imperforate resilient sealing member 27 which conveniently may take the form of a rubber membrane held in place by a resilient ring 28 of suitable material. Disposed within the valve stem with its upper end adjacent the upper end of that stem is a magnetic core member 29. A suitable adhesive material 30 serves to attach the core member to the interior of the stem and to effect a seal between the respective surfaces.

The length of the valve stem is such that with the member 27 resting upon the top edge of the upper stem 12 of the pipette, the magnetic core 29 will be operatively within the field of the solenoid coil 23, and when the member 27 is fully lifted to permit filling of the pipette only a small space, for example, about two millimeters, will separate the member 27 and the top edge of stem 12. As will be apparent, when the pipette has been filled with liquid a liquid film is present over the upper edge of stem 12 and when the valve is dropped into contact with that upper edge a tight seal will result. Of particular significance, the valve is exterior of the pipette itself and in no way changes the fixed volume of the pipette. Moreover, the short distance between the member 27 and the upper edge of stem 12 during the filling operation serves to obviate the "fountain effect" and thus reduces the excess amount of liquid drawn into the pipette.

A pipette as described above may be used singly, or in a plural arrangement, in accordance with the invention, but in any event is intended for mounting so as to be movable vertically in relation to beakers which it is

to serve. Preferably, a multi-unit assembly is used in cooperation with a stationary frame having a floor portion 35, side wall portions 36, 37 and a cover portion 38. Each pipette is removably secured to a suitable mounting panel 40 by means, for example, of upper and lower spring clamps 41 and 42 embracing the body portion of the pipette and with a similar clamp 39 embracing the chamber 13. The several panels 40 may in turn be mounted in horizontally spaced parallel relation at the same height above floor 35 by any suitable structure.

A suitable type of solenoid coil for use with the invention is Model GPD manufactured by Potter and Brumfield Company, Marion, Ky., and conveniently this coil may be mounted between the cover 22 of the chamber 13 and the lower face of a metallic bracket 90 which in turn is affixed to the upper part of plate 40. The bracket material serves the useful additional purpose of acting as a heat sink and preventing the heat generated in the solenoid coil from reaching the contents of the pipette.

One mounting structure for the pipettes which has the advantage of providing for variation in the spacings between adjacent pipettes, and which is preferred, may include a lazy-tong mechanism such as indicated diagrammatically in FIG. 5. In this arrangement a rigid elongated rod 45 whose ends are free to travel vertically and without turning in brackets affixed to the inner surfaces of the side wall portions of the frame, may be mounted as indicated by bracket 46 in FIG. 1. Projecting horizontally to one side of rod 45 at the center of the same and rigidly attached thereto, as by means of a set screw 45A, is a hub 47 (FIG. 6) upon which the center links 48, 49 of the tongs are pivoted.

The hub 47 has a lateral hole therein adjacent one end for receiving the rod 45 and terminates at its other end in an axially tapped, offset bearing portion 50 upon which the links 48, 49 are pivotally arranged. A headed screw 51 bearing upon a washer 52 serves to hold the links in position. At their top ends links 48 and 49 are pivotally connected as by pins 53 and 54 to the next adjacent links 55, 56 and at their bottom ends are pivotally connected as by pins 57, 58 to the next adjacent links 59, 60. In similar fashion links 55 and 56 are connected to one set of links 61 and 62 and links 59 and 60 are connected to the other set of links 63 and 64. Links 61 and 64 are also connected to links 65 and 66 at one end of the assembly.

In contrast with the mounting of the central links 48 and 49 upon a hub rigidly attached to rod 45, the remaining links are mounted upon hubs such as seen in FIG. 6A and wherein the hub so indicated at 70 is free to slide along rod 45. Referring now to FIG. 7, the pins which connect the respective upper ends of pairs of links as illustrated at 71 and the pins which connect the respective lower ends of such links as illustrated at 72 have lateral holes therethrough for reception of lifting rods 73 one of which is associated with each of the pipette mounting panels 40. Spacers 74, 75 hold the panels in proper relation to the lifting rods. The inner ends of pins 71 and 72 have an offset bearing portion about which the links may pivot and headed bolts 76, 77 serve to hold the links in place. By means of a set screw 78 entering the lower pin 72 from its outer end, the elevation of the rod 73, panel 40 and lower end 11 of the pipette with respect to the beakers to be served is thus determined. After this set screw is tightened the lazy-tong action of the links will raise or lower the assembly and with rod 73 moving freely through the upper pin 71.

As shown in FIG. 8 the width of a panel 40 is greater than the outer side dimensions of the clamp 39 which is intended to embrace the capping chamber at its greatest diameter. The clamp is held securely in place by a bolt 79 exerting tension thereupon and bearing upon the rear-side of the panel. Accordingly, when fully collapsed the several panels of the assembly may abut side by side

without damage to the pipettes and may occupy a space which is about one third of that occupied when the links are fully extended. Thus a wide range of spacings of beakers served by the pipettes is made possible.

The weight of the described lazy-tong structure and attached pipettes is preferably balanced by a counterweight assembly as indicated at 80 and including a cable 81 attached to rod 45 and passing over a pulley 82. A handle 83 affixed to the upper free end of link 62 may be used to adjust the spacing of the pipettes so as to enable them to be raised and lowered in register with the several beakers 89. As will be understood, such beakers will normally be positioned in a tray (not shown) and will be removed from and presented to the lower ends of the pipettes in a prescribed array.

The pressure manifold 17 as well as the drain manifold 20 may be mounted either rigidly or otherwise upon the stationary frame and preferably are connected to the respective conduits 16 and 19 of the pipettes by flexible hoses having sufficient length to accommodate raising and lowering of the pipettes and adjustments in their relative spacings. If desired, the manifolds may be mounted so as to partake of movement of the rod 45 rather than being mounted upon the stationary frame. As shown in FIG. 9 the electrical conductors 91, 92 serving the respective solenoid coils 23, and connected thereto in parallel, likewise are provided with sufficient slack to accommodate the pipette movements. Conveniently, the energization of the coils may be controlled by a conventional switch 93 mounted upon the side wall 37 of the frame and located adjacent the manifold control valves 18 and 21.

The wall 37 of the frame may also provide a mounting for the terminals of the electrical cables 94 and 95 leading to the conductors 80 and 81.

With the foregoing description in mind, the advantages of the invention will now be apparent from the following description of a typical multi-unit pipetting operation. At the beginning, the array of empty pipettes are in raised position, valves 18 and 21 are closed, and switch 93 is open. At this time, the sealing member 27 of each of the magnetic valves is resting loosely upon the top edge of the respective upper stems of the pipettes. When the array of filled beakers 89 are in position the operator then lowers the pipettes as a unit and when fully lowered then closes switch 93 causing the magnetic valves to lift. Thereupon, valve 21 is opened and liquid is quickly drawn into each pipette, but without a significant "fountain effect." When it is certain that each pipette is completely filled as evidenced by liquid spilling into each of the capping chambers, valve 21 is closed and switch 93 is opened. As the sealing surfaces 27 of the respective magnetic valves then contact the wetted lips of the upper ends of the stems 12 of the pipettes, a reliable reinforcing seal is established and which prevents any later dispensing of drops of liquid from the pipettes due to vibration or to possible breakage of the seal maintained by member 15.

The thus filled pipettes are then raised as a unit and an array of different beakers 89 is then brought into place. The switch 93 is then closed causing the magnetic valves to rise and valve 18 is then opened to supply superatmospheric pressure into the capping chambers. A prompt dispensing of the entire contents of the pipettes then results. After this occurs, valve 18 is closed and switch 93 is reopened after which the apparatus is in readiness for its next pipetting operation. As will be apparent, if the subsequent operation involves the use of an array of beakers from each other at distances different from these of the preceding operation, the spacing of the pipettes are adjusted accordingly merely by manipulation of handle 83.

Manifestly the invention, as illustrated and described, is susceptible of modification without departing from the invention concept.

What is claimed is:

1. A pipetting apparatus comprising, a frame, a fixed

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volume pipette having a body portion with an open upper stem and an open lower stem projecting therefrom, means supporting said pipette on said frame for vertical movement with respect thereto, a hollow capping chamber removably surrounding the upper portion of said pipette and having a tubular valve stem guide arranged axially of said pipette above the upper open end of said upper stem, a valve having a lower sealing face adapted to seat upon the open upper end of said upper stem and a metallic core slidable in said guide, sealing means disposed between the exterior surface of said pipette and the lower end of said chamber, a laterally extending lower conduit connected to said chamber below the open upper end of said upper stem and to a source of vacuum, an upper conduit connected to said chamber adjacent the open upper end of said upper stem and to a source of gas under superatmospheric pressure, an electrical coil adapted to lift said metallic core thereby to raise said valve from its seat on said upper stem, means for selectively connecting and disconnecting said coil to and from an electrical circuit, and means for selectively opening and closing said conduits thereby to effect the filling and the emptying of said pipette.

2. A multiple-unit pipetting apparatus comprising a frame; a plurality of fixed volume pipettes arranged in parallel relation to each other and at a uniform height; means supporting said pipettes upon said frame for vertical movement as a unit with respect to said frame and for adjusting the lateral spacing between adjacent pipettes; each of said pipettes having a body portion with an open upper stem and an open lower stem projecting therefrom, a hollow capping chamber removably surrounding the upper portion of the pipette, sealing means disposed between the exterior surface of the pipette and the lower end of said chamber, a laterally extending lower conduit connected to the chamber below the open upper end of the upper stem, and an upper conduit connected to said chamber adjacent the open upper end of the upper stem; a manifold connected to the respective lower conduits and to a source of vacuum; a manifold connected to the respective upper conduits and to a source of gas under

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superatmospheric pressure; and means for selectively opening and closing said manifolds to and from said sources thereby to permit each of said pipettes to fill and to empty simultaneously.

3. A multiple-unit pipetting apparatus comprising a frame; a plurality of fixed volume pipettes arranged in parallel relation to each other and at a uniform height; means supporting said pipettes upon said frame for vertical movement as a unit with respect to said frame; each of said pipettes having a body portion with an open upper stem and an open lower stem projecting therefrom, a hollow capping chamber removably surrounding the upper portion of the pipette, sealing means disposed between the exterior surface of the pipette and the lower end of said chamber; a magnetically operated valve contained in each of the respective capping chambers and adapted when de-energized to seal the upper end of the respective upper stems and when energized to break said valve sealing; means for selectively energizing and de-energizing said valves simultaneously in preparation for a simultaneous filling of said pipettes and for a simultaneous emptying of said pipettes; a laterally extending lower conduit connected to the chamber below the open upper end of the upper stem; and an upper conduit connected to said chamber adjacent the open upper end of the upper stem; a manifold connected to the respective lower conduits and to a source of vacuum; a manifold connected to the respective upper conduits and to a source of gas under superatmospheric pressure; and means for selectively opening and closing said manifolds to and from said sources thereby to permit each of said pipettes to fill and to empty simultaneously.

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