United States Patent

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[54] FLOW CONTROL APPARATUS

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[52] **U.S. Cl.** **73/425.6**

[51] **Int. Cl.** **B011 3/02**

[58] **Field of Search** 73/425.6; 141/21, 22, 23, 24, 141/25; 23/253, 259, 292

[56] **References Cited**

UNITED STATES PATENTS

3,310,002	3/1967	Wilburn	73/425.6
3,463,013	8/1969	Reedy	73/425.6
3,607,082	9/1971	Thiers	73/425.6

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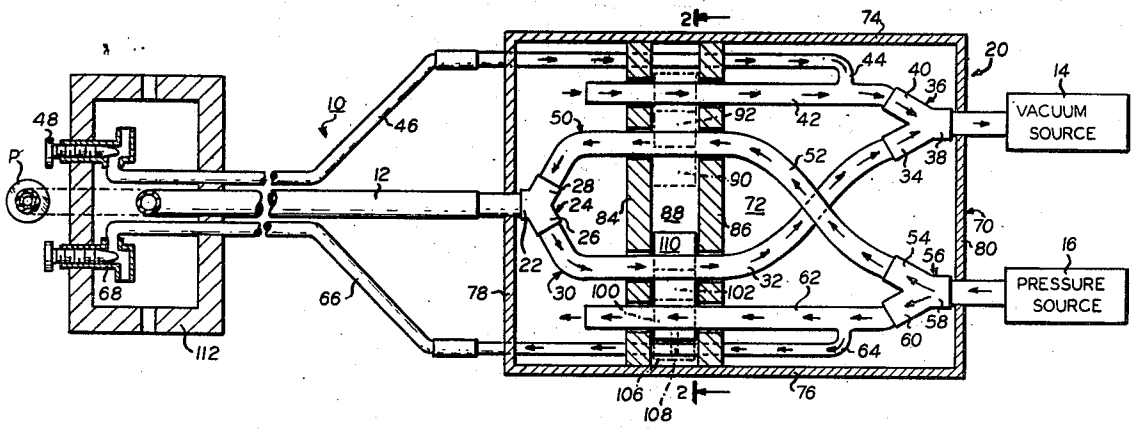
[57] **ABSTRACT**

An apparatus for controlling the flow of liquid into and out of a transfer vessel comprises a vacuum source and a pressure source, both connected by branched flexible tubing to the transfer vessel and the atmosphere, with a bleeder control valve provided to adjust vacuum or pressure in each respective connecting line, and a pair of clamping members to be opened or closed selectively, resulting in either the aspiration of liquid into, or the expulsion of liquid from, the transfer vessel at an adjustably controlled rate as desired.

5 Claims, 3 Drawing Figures



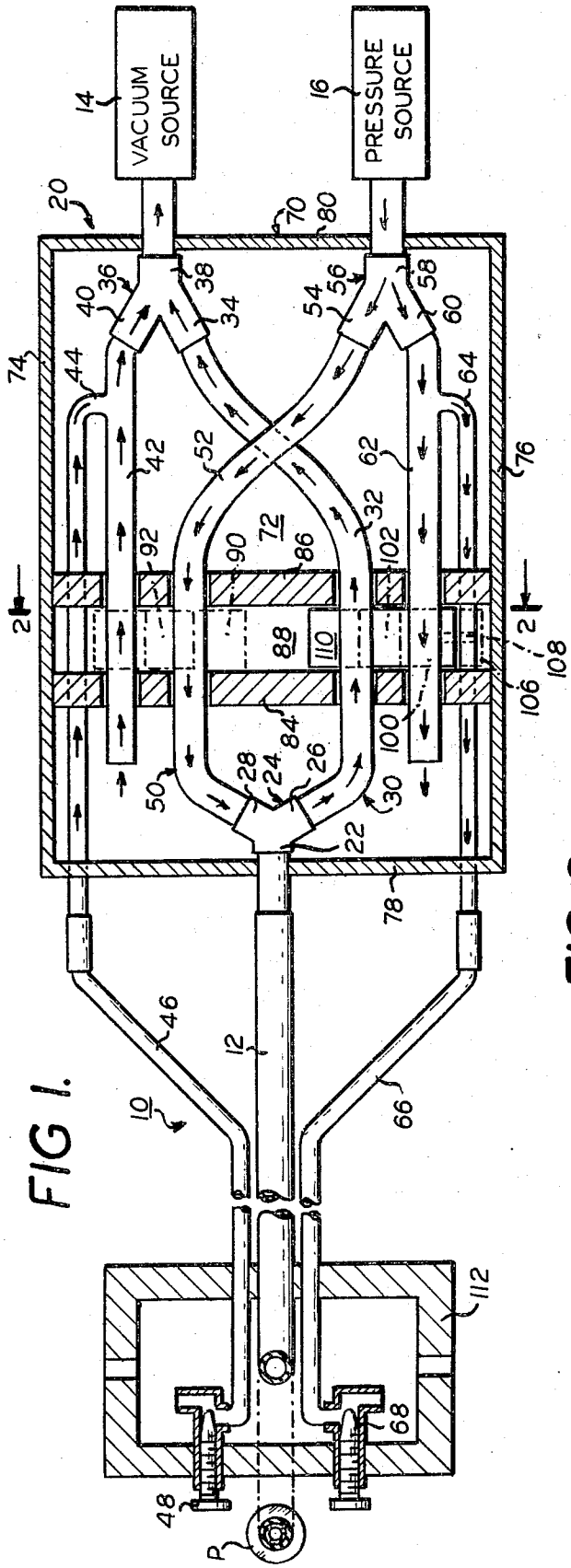


FIG 1.

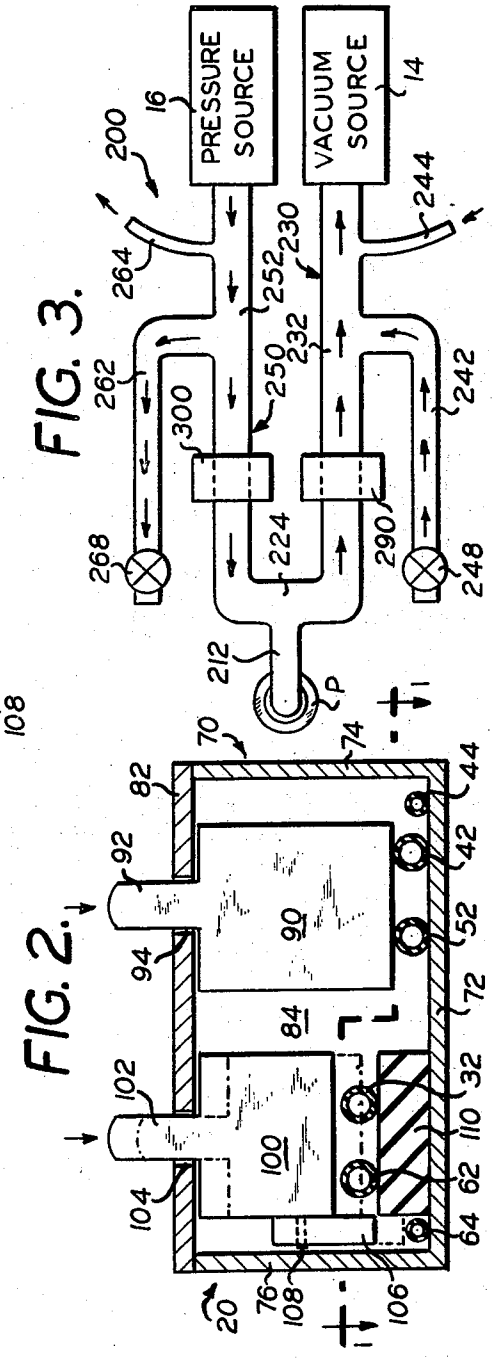


FIG. 3.

FIG. 2.

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FLOW CONTROL APPARATUS

BACKGROUND OF THE INVENTION

Liquid transfer in the laboratory is carried out conventionally by sucking liquid into a transfer vessel, e.g. a pipette, by mouth, holding a finger over the top opening of the pipette to retain the liquid therein, and then removing the finger to permit outflow of the liquid by gravity. Considerable manipulative skill is required to perform this operation cleanly, and the hazard of oversucking, resulting in liquid entering the mouth, constantly exists. This may be merely unpleasant, or quite dangerous if the liquid is corrosive, radio active, volatile or toxic. In addition, the transfer of a viscous liquid requires strong suction to aspirate the liquid into, and considerable time to await the gravity drainage out of, a pipette.

It is therefore apparent that an apparatus for filling, maintaining liquid in, and evacuating a pipette mechanically, with minimum manipulation, no oral suction, and complete rate-of-flow control, is a most desirable achievement.

SUMMARY OF THE INVENTION

This invention relates to apparatus for liquid flow control in filling and draining a liquid transfer vessel such as a pipette. Vacuum and pressure sources are provided, with branched resiliently flexible tubing affording potential communication between the pipette and each source, and between the atmosphere and each source. Two clamping members are used alternately for regulating or interrupting these communications, so that the actuation of one clamping member permits vacuum to be applied to the pipette, aspirating liquid in, while actuation of the other allows pressure to reach the pipette and expel the liquid.

It is a prime object of this invention to provide an efficient, easily operable flow control device for liquid transfer.

It is a further object of this invention to provide a liquid transfer flow control apparatus, eliminating oral suction and its attendant disadvantages by mechanically applying either vacuum or pressure to the liquid at will in a fully controlled manner.

Other objects and advantages of this invention will become apparent from the descriptions of the illustrative examples which follow.

DRAWINGS

In the drawings,

FIG. 1 is a somewhat schematic plan view of a preferred embodiment of this invention, partially in section taken generally along line 1—1 of FIG. 2;

FIG. 2 is a transverse sectional view taken along line 2—2 of FIG. 1; and

FIG. 3 is a schematic plan view of an alternate embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 discloses flow control apparatus **10**, designed to fill pipette P with liquid (not shown) by vacuum aspiration, and in similar manner, to expel the liquid from pipette P as desired by positive pressure.

A common flexible conduit **12** connects the top of pipette P with both vacuum source **14** and pressure source **16** through selective flow control unit **20**. More specifically, conduit **12** is connected to one branch **22** of three-way connector **24**; branches **26** and **28** of connector **24** are operatively joined to vacuum conduit system **30** and pressure conduit system **50**, respectively.

Vacuum conduit system **30** includes main vacuum line **32**, extending from connector **24** to branch **34** of three-way connector **36**; branch **38** of which leads directly to vacuum source **14**. Third branch **40** of connector **36** is joined to one end of vacuum exhaust line **42**, the other end of which is open to the atmosphere. Sensitivity control vacuum line **44** branches from line **42** and connects through extension line **46** to vacuum exhaust bleeder valve **48**, the outlet of which is also open to the atmosphere.

Quite analagously to vacuum conduit system **30**, pressure conduit system **50** has a main pressure line **52** extending from connector **24** to branch **54** of three-way connector **56**, branch **58** of which leads directly to pressure source **16**. Third branch **60** of connector **56** holds one end of pressure exhaust tube **62**, the other end of which is open to the air. Sensitivity control pressure line **64** branches from line **62** and connects through extension line **66** to pressure exhaust bleeder valve **68**, open at its outlet to the atmosphere.

Alternatively, control vacuum line **44** may brahch directly from the main vacuum line **32** in the region extending between clamping chamber **88** (as hereinafter defined) and the three-way connector **36**. Similarly, control pressure line **64** may branch directly from the main pressure line **52** in the region extending between said clamping chamber **88** and the three-way connector **56**.

Flow control unit **20**, which contains connectors **24**, **36**, and **56** and conduit lines **32**, **42**, **44**, **52**, **62**, and **64**, includes a substantially box-like housing **70**, with a base **72**, side walls **74** and **76**, end walls **78** and **80**, and a cover **82** (FIG. 2). Vertical parallel guide walls **84** and **86** extend across the interior of housing **70** and define therebetween a valving or clamping chamber **88**. Shut-off clamping plates **90** and **100** are positioned between walls **84** and **86** in a vertically slidable manner.

Clamping plate **90** has a pedal (or handle) **92** extending upwardly through opening **94** of housing cover **82**, while clamping plate **100**'s pedal **102** protrudes through opening **104** of housing cover **82**. Auxiliary clamping finger **106** is adjustably attached to the side of plate **100** by screw **108**.

Conduits **32**, **42**, **44**, **52**, **62** and **64**, all composed of resiliently flexible tubing, extend through suitable openings in guide walls **84** and **86** across clamping chamber **88**. As may be clearly seen in FIG. 2, main pressure line **52** and vacuum exhaust tube **42** rest on base **72** of housing **70** directly under, and in position to be controlled by, clamping plate **90**. Vacuum sensitivity control line **44** is located on base **72** without clamp control. Main vacuum conduit **32** and pressure exhaust line **62** are positioned under clamping plate **100** on a resilient member **110** which is mounted on base **72** of housing **70**. Pressure sensitivity control tube rests on base **72** under auxiliary clamping finger **106**.

As shown in FIG. 1, sensitivity control vacuum exhaust valve 48 and pressure exhaust valve 68 may be conveniently mounted together in a housing 112 within easy reach of pipette P.

OPERATION OF PREFERRED EMBODIMENT

During use of the apparatus 10 of this invention, both vacuum and pressure sources are continuously operative. At rest or neutral position, clamping plates 90 and 100 are in their upper, or disengaged, position shown in solid lines in FIG. 2, and, since both exhaust lines are open to the atmosphere, the system is balanced, so that neither suction nor pressure exists in the conduit lines nor is applied to the pipette.

In order to aspirate liquid into the pipette, clamping plate 90 is depressed by applying downward pressure on pedal 92. This action begins to close off vacuum exhaust line 42 and main pressure line 52, permitting the main vacuum line 32 to apply suction to pipette P and to aspirate liquid therein. Further depression of pedal 92 closes lines 42 and 52 more and increaes the vacuum applied to pipette P. In this manner, vacuum, and consequently liquid flow rate, may be regulated. Additional flow control is available by the adjustment of vacuum sensitivity bleeder valve 48. When pipette P has been filled to the desired level, release of pedal 92 reopens lines 42 and 52, restores the original pressure-vacuum balance, and renders the system inactive.

For delivery of the liquid now contained in pipette P, pedal 102 may be variably depressed, lowering clamping plate 100 and applying pressure to the pipette through main pressure line 52. In the intermediate dot-dash position of FIG. 2, main vacuum line 32 and pressure exhaust line 62 are closed by clamping plate 100, and pressure from main pressure line 52, adjustable through pressure bleeder valve 68 and sensitivity control line 64, forcibly ejects liquid from pipette P. For maximum delivery pressure, further depression of pedal 102 lowers clamping plate 100, compressing resilient member 110 and permitting auxiliary clamping finger 106 to close off pressure sensitivity control line 64.

It is to be noted that pedals 92 and 102, while designed for foot control leaving the hands free for valve and/or pipette manipulation, may be manually actuated as well.

ALTERNATE EMBODIMENT

The flow control apparatus 200 of FIG. 3 connects pipette P through common conduit 212 and junction point 224 to both branched vacuum conduit system 230 and branched pressure conduit system 250.

Vacuum conduit system 230 includes main vacuum line 232, extending from juncture point 224 to vacuum source 14; branch exhaust line 242, connecting main vacuum line 232 with exhaust control valve 248; and branch vacuum bleeder line 244, joined to main vacuum line 232 at one end and open to the atmosphere at the other.

Similarly, pressure conduit system 250 has main pressure line 252 joining common juncture 224 with pressure source 16; pressure exhaust line 262 connecting main pressure line 252 with pressure exhaust control valve 268; and pressure bleeder line 264 connecting main line 252 with the atmosphere.

Clamping member 290 is situated on main vacuum line 232, and clamping member 300 controls main pressure line 252.

In use, the apparatus of this embodiment keeps both pressure and vacuum sources constantly operative, but, in contrast to the embodiment of FIGS. 1 and 2, neutral or rest position is maintained with clamping members 290 and 300 closed and lines 232 and 252 shut off. In this situation, a working vacuum exists in line 232 between clamping member 290 and vacuum source 14, relieved by bleeder line 244 and further controllable by valve 248 through line 242. Similarly, working pressure in line 252 between clamp 300 and pressure source 16 is maintained by relief bleeder line 264 and pressure control valve 268.

The opening of clamping member 290 permits vacuum to reach pipette P and draw liquid in, its rate of flow controlled by valve 248; reclosing clamp 290 returns the system to neutral position with pipette P filled. Now, release of clamping member 300 opens main pressure line 252 and discharges the pipette's contents at a rate of flow controlled by valve 268.

Thus, examples of efficient apparatus for controlling the flow of liquid into and out of a transfer vessel have been described, illustrating but not restrictive of the concepts of this invention, which are limited only by the scope of the appended claims.

I claim:

1. Apparatus for controlling the flow of liquid in filling and emptying a transfer vessel, comprising:
- a vacuum source;
- a pressure source;
- resiliently flexible branched vacuum conduit means for operatively connecting said vacuum source both to the transfer vessel and to the atmosphere;
- resiliently flexible branched pressure conduit means for operatively connecting said pressure source both to the transfer vessel and to the atmosphere;
- first clamping means for regulating conduit communication between the transfer vessel and said pressure source; and
- second clamping means for regulating conduit communication between the transfer vessel and said vacuum source.

2. Apparatus as described in claim 1, wherein:
- said branched vacuum conduit means comprises: a main vacuum conduit operatively connected at one end to said vacuum source; a first branch vacuum conduit operatively joined at one end to said main vacuum conduit and open to the atmosphere at its other end; a second branch vacuum conduit operatively joined at one end to said main vacuum conduit; and a vacuum control valve connected to the distal end of said second branch vacuum conduit, the outlet of said vacuum control valve leading to atmosphere; and
- said branched pressure conduit means comprises: a main pressure conduit operatively connected at one end to said pressure source; a first branch pressure conduit operatively joined at one end to said main pressure conduit and open to the atmosphere at its other end; a second branch pressure conduit operatively joined at one end to said main pressure conduit; and a pressure control valve connected to the distal end of said second

branch pressure conduit the outlet of said pressure control valve leading to atmosphere.

3. Apparatus as described in claim 2, wherein:

said first clamping means is held open in its inoperative position, and comprises; a clamping plate mounted for vertically slidable motion between two parallel guide walls and adapted to regulate conduit communication in both said main pressure conduit and said first branch vacuum conduit simultaneously; and

said second clamping means is held open in its inoperative position, and comprises; a clamping plate mounted for vertically slidable motion between two parallel guide walls and adapted to regulate conduit communication in both said main vacuum conduit and said first branch pressure conduit simultaneously.

4. Apparatus as described in claim 3, wherein:

said second clamping means further comprises: an auxiliary clamping finger adjustably affixed to said clamping plate of said second clamping means and adapted to regulate conduit communication in said second branch vacuum conduit sequentially to the regulation of said main vacuum conduit and said first branch pressure conduit.

5. Apparatus as described in claim 2, wherein:

said first branch vacuum conduit and said first branch pressure conduit each comprises a bleeder exhaust line;

said second branch vacuum conduit said said second branch pressure conduit each comprises a principal exhaust line, the former adjustably controlled by said vacuum control valve, the latter adjustably controlled by said pressure control valve;

said first clamping means is closed in its inoperative position and is adapted to regulate conduit communication in said main pressure conduit; and

said second clamping means is closed in its inoperative position and is adapted to regulate conduit communication in said main vacuum conduit.

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