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3,341,076

FLUID PRESSURE-OPERATED BURETTE SYSTEM

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2 Sheets-Sheet 1

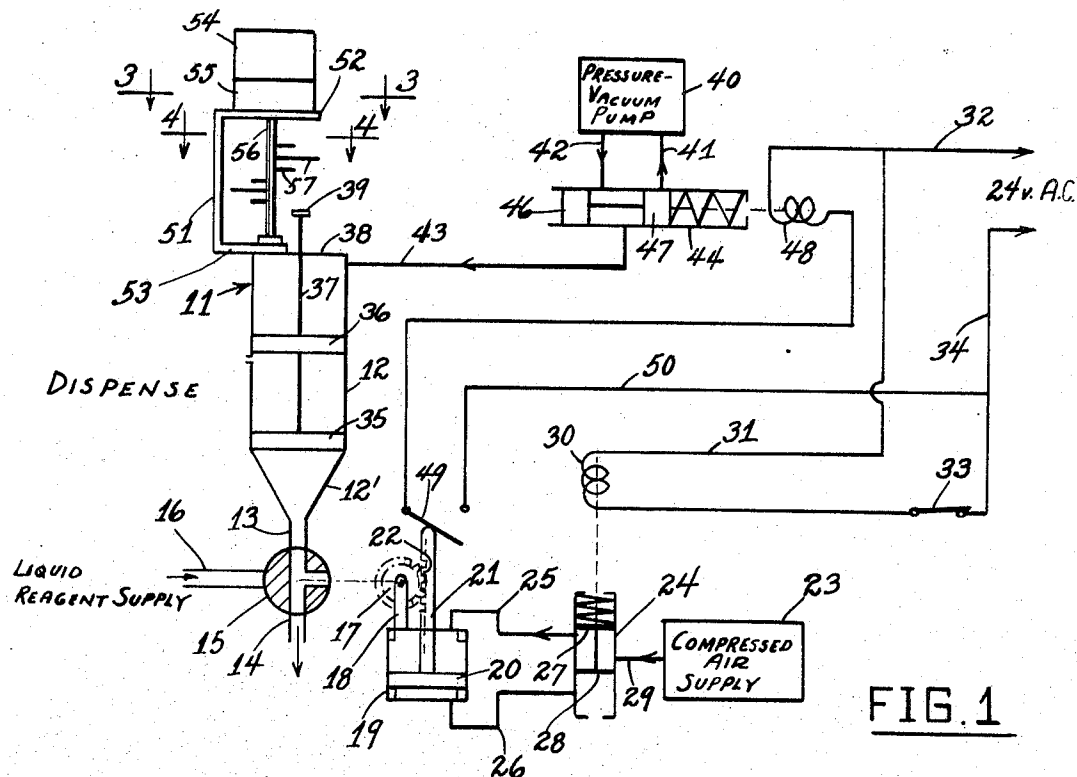


FIG. 1

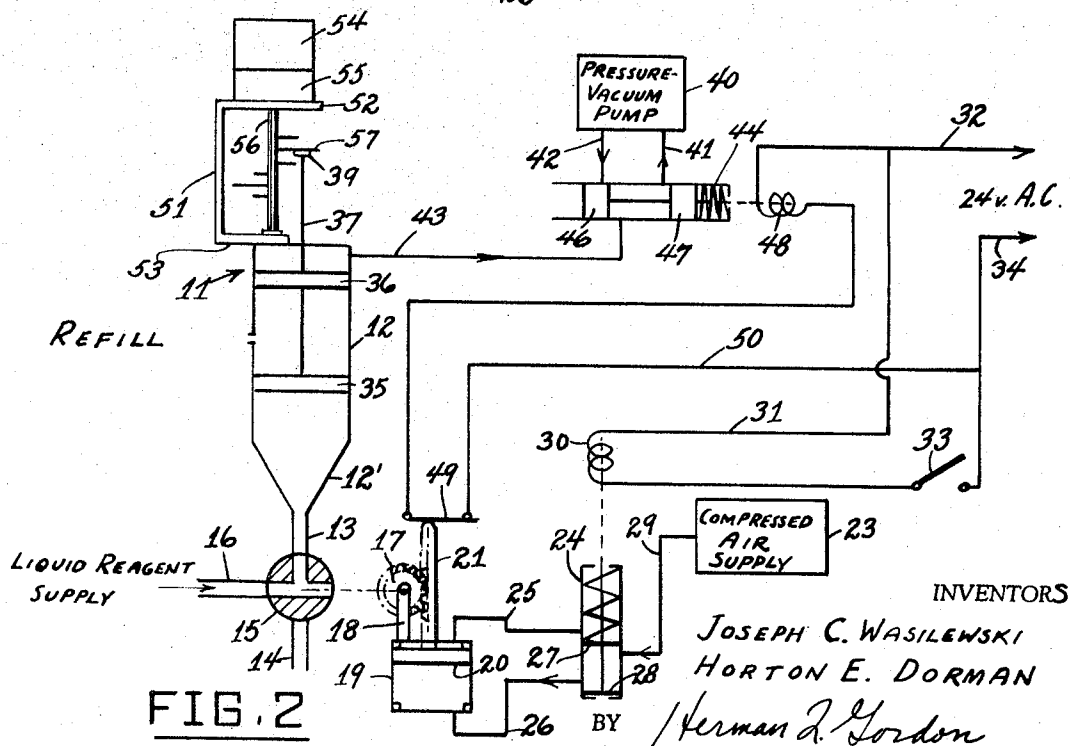


FIG. 2

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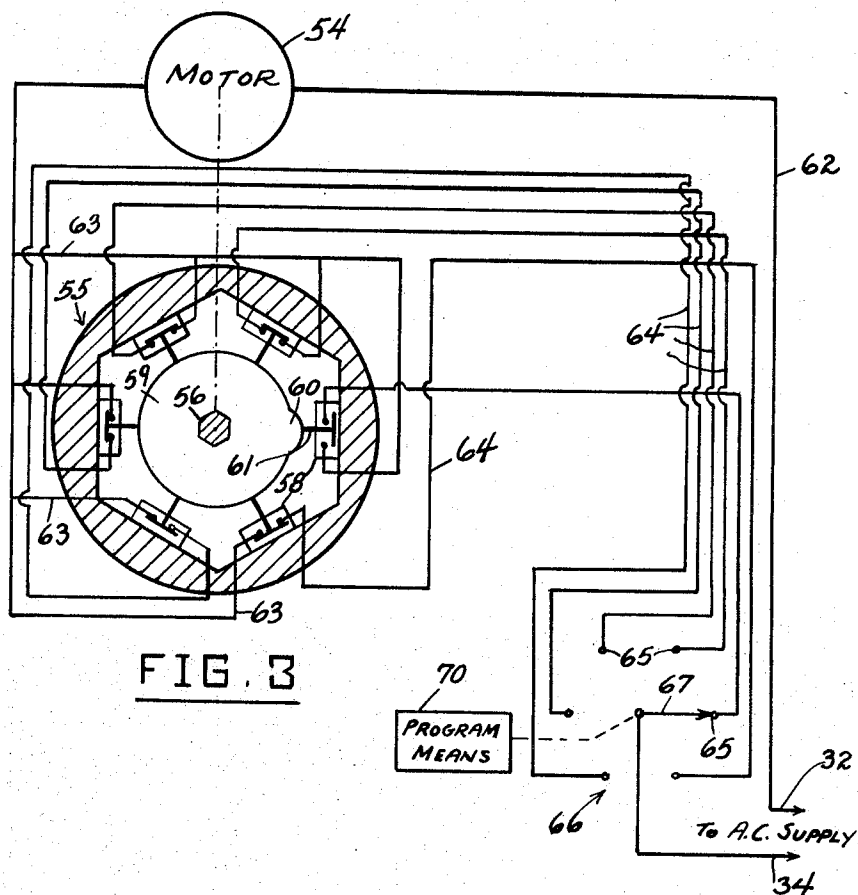
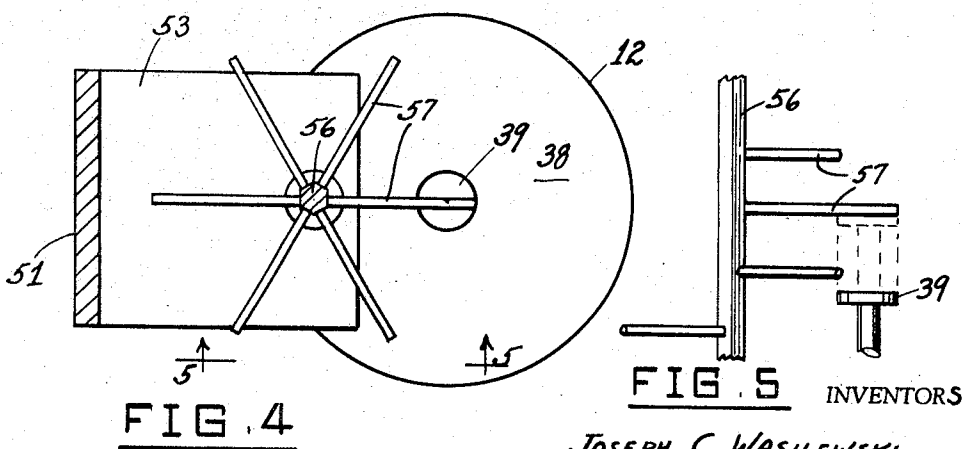
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1

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FLUID PRESSURE-OPERATED BURETTE SYSTEM

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9 Claims. (Cl. 222—76)

ABSTRACT OF THE DISCLOSURE

A dispensing burette assembly consisting of a syringe cylinder having a double piston with a piston rod extending through its top wall and engageable with an adjustable stop. The adjustable stop consists of a rotary turret having vertically spaced radial stop rods. The turret is provided with a servo driving motor arrangement. The discharge end of the burette has a three-way valve to alternately connect the burette to a supply conduit and a discharge conduit. The three-way valve is operated by an air cylinder actuated from a compressed air supply through a solenoid valve whose energizing circuit includes a control switch. A pressure-vacuum source operates the syringe cylinder through a reversing solenoid valve whose energizing circuit includes a control switch operated by the same air cylinder employed to actuate the three-way valve.

This invention relates to fluid dispensing devices, and more particularly to a fluid pressure-operated burette and a control system therefor, whereby the burette may be employed to dispense selected accurately measured volumetric quantities of fluids.

A main object of the invention is to provide a novel and improved burette device which is relatively simple in construction, which is easy to operate, which can be remotely controlled, and which can be adjusted to accurately dispense any selected one of a plurality of predetermined different known quantities of a fluid.

A further object of the invention is to provide an improved burette apparatus of the air-operated type, said apparatus being electrically controlled, being automatic in operation, and being suitable for use in a system wherein it may be activated from a remote location and/or in a timed or programmed mode.

A still further object of the invention is to provide an improved burette device and control system therefor which involves relatively inexpensive components, which is reliable in operation, which is extremely versatile in its performance, and which may be adjusted and operated from a remote location, so that it is applicable for a wide range of uses, such as for the quantitative analysis of fluids or process liquids, for the automatic dilution of reagents, for automatic sampling and dilution of fluids in a process stream, and for many other useful and important purposes related to the automatic handling of liquids and other materials.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a schematic diagram of an improved burette and control system therefor constructed in accordance with the present invention, with the parts thereof shown in fluid dispensing positions.

FIGURE 2 is a schematic diagram similar to FIGURE 1 but with the parts shown in burette-refilling positions.

FIGURE 3 is an enlarged horizontal cross-sectional detail view taken substantially on the line 3—3 of FIGURE 1 and showing the electrical circuit associated with

2

the burette capacity-adjusting means employed in the system in accordance with the present invention.

FIGURE 4 is an enlarged horizontal cross-sectional view taken substantially on the line 4—4 of FIGURE 1.

FIGURE 5 is a fragmentary elevational view taken substantially on the line 5—5 of FIGURE 4.

Referring to the drawings, 11 generally designates an air-operated burette assembly of the same general type as is disclosed in my prior U.S. Patent No. 3,180,527, issued Apr. 27, 1965, and entitled "Air-Operated Burette." The assembly 11 comprises a cylinder 12 having a generally frusto-conical downwardly convergent lower portion 12' communicating with a fluid delivery conduit 13. The conduit 13 is connected to a discharge conduit 14 through a rotary three-way valve 15. A liquid reagent supply conduit 16 is also connected to said delivery conduit through the three-way valve 15, the valve having a rotary core which is formed with passages connecting delivery conduit 13 to discharge conduit 14 in one position of the core (as in FIGURE 1), and connecting supply conduit 16 to delivery conduit 13, while closing off discharge conduit 14, in a second position of the core (as in FIGURE 2).

The core of the three-way valve 15 is drivingly connected to a gear 17 journaled on an upstanding support 18 carried by a compressed air cylinder 19 suitably mounted adjacent the burette cylinder 12. Cylinder 19 contains a piston 20 having a piston rod 21 extending slidably and sealingly through the top wall of the cylinder 19 and formed with rack teeth 22 meshing with the teeth of gear 17. A suitable compressed air supply source 23 is connected through a solenoid-operated selector valve 24 and respective conduits 25 and 26 to the top and bottom ends of cylinder 19.

Valve 24 includes spaced rigidly connected piston elements 27 and 28 located to communicatively connect the outlet conduit 29 from the compressed air source 23 to conduit 26 when the solenoid coil 30 of the valve is de-energized (as in FIGURE 2) and to allow conduit 25 to be vented. Under these conditions, piston 20 is elevated in cylinder 19 and three-way valve 15 is adjusted to communicatively connect reagent supply conduit 16 to conduit 13, as in FIGURE 2. When solenoid coil 30 is energized, as in FIGURE 1, the piston elements 27, 28 are located to communicatively connect air conduit 29 to conduit 25, causing piston 20 to be depressed in cylinder 19 and allowing conduit 26 to be vented. This adjusts three-way valve 15 to the position of FIGURE 1, blocking supply conduit 16 and communicatively connecting delivery conduit 13 to the discharge conduit 14.

One terminal of solenoid coil 30 is connected by a wire 31 to a first supply wire 32. The other terminal of the solenoid coil is connected through a control switch 33 to a second supply wire 34.

The burette cylinder 12 contains a pair of spaced rigidly connected pistons 35 and 36, said pistons being rigidly connected by a piston rod 37 which extends slidably and sealingly through the top wall 38 of the cylinder and which is provided at its top end with an enlarged abutment head 39.

Designated at 40 is a conventional pressure-vacuum pump, such as a "Dyna-Vac" pump, or any other similar pump having both suction and pressure connections. The suction line leading to pump 40 is shown at 41 and the pressure line from pump 40 is shown at 42. Lines 41 and 42 are selectively connected by a solenoid-operated valve 44 to a conduit 43 connected to the top end portion of burette cylinder 12.

Valve 44 comprises a cylinder containing the spaced rigidly-connected pistons 46 and 47 located so that when the solenoid coil 48 of the valve is deenergized (as in FIGURE 1), pressure line 42 is communicatively con-

nected to conduit 43, which delivers pressure fluid to cylinder 12, causing the pistons 35 and 36 to descend and thereby discharging reagent from the burette. When solenoid coil 48 is energized (as in FIGURE 2) the pistons 46, 47 are moved to positions wherein conduit 43 is communicatively connected to the pump suction line 41, causing the pistons 35, 36 to be elevated, whereby to develop suction in the lower portion of cylinder 12 and to cause liquid reagent from conduit 16 to be drawn into the cylinder, as will be presently described.

One terminal of the valve solenoid coil 48 is connected to supply wire 32. The other terminal of said coil is connected through a switch 49 and a wire 50 to supply wire 34. Switch 49 is suitably mounted above cylinder 19 so that its pole is actuated by the top end of piston rod 21 to close the switch when the piston 20 is elevated substantially to the position of FIGURE 2 responsive to the opening of the main control switch 33. Thus, when the main control switch 33 is opened, valve solenoid 30 becomes deenergized, allowing pistons 27, 28 to descend to their positions of FIGURE 2, thereby communicatively connecting conduit 29 to conduit 26, which introduces compressed air into the lower end of cylinder 19, causing piston 20 to rise and causing piston rod 21 to rotate the core of three-way valve 15 to a position connecting liquid reagent supply conduit 16 to delivery conduit 13 and at the same time closing switch 49. This energizes valve solenoid coil 48, moving pistons 46, 47 to positions communicatively connecting suction line 41 to conduit 43. The suction in the top end of cylinder 12 raises pistons 35, 36 to the position of FIGURE 2, namely, to the limit of upward movement of abutment head 39, to reset the burette, drawing a definite volume of liquid reagent into the cylinder below piston 35.

When control switch 33 is subsequently closed, valve solenoid coil 30 becomes energized, elevating valve pistons 27, 28 to the positions of FIGURE 1 and connecting pressure line 29 to conduit 25, whereby piston 20 descends and opens switch 49 and simultaneously restores three-way valve to the discharge position thereof shown in FIGURE 1. When switch 49 opens, coil 48 becomes deenergized, allowing pistons 46, 47 to move to positions (shown in FIGURE 1) wherein pressure line 42 is connected to conduit 43, thereby driving pistons 36, 37 downwardly through their discharge stroke.

The volume of the dispensed reagent may be regulated by controlling the permissible upward movement of the abutment head 39 during the refill or upward stroke of pistons 35, 36. This is accomplished by providing adjustable stop means above the abutment head. Said stop means is preferably of a type which can be adjusted from a remote location or which can be varied in a timed or programmed mode. Thus, in the typical arrangement illustrated herein, a generally C-shaped bracket 51 is mounted on the top wall 38 of cylinder 12, said bracket having the horizontal top arm 52 and the horizontal bottom arm 53. A synchronous motor 54 provided with a servo switching assembly 55 is mounted on top arm 52, the motor shaft 56 extending vertically and rotatably through top arm 52 and being journaled in bottom arm 53. The shaft portion between arms 52 and 53 is hexagonal in cross-sectional shape and is provided with vertically spaced radially extending stop arms 57 secured on the respective faces of the hexagonal shaft portion. The stop arms are of sufficient length to be engaged by abutment head 39 in the manner shown in dotted view in FIGURE 5 when a selected stop arm is positioned in vertical registry with the abutment head.

As shown in FIGURE 3, servo switch assembly 55 comprises a casing concentric with shaft 56 having a hexagonally shaped interior. Mounted on the respective interior faces of the casing are normally closed microswitches 58 coplanar with a cam disc 59 secured on shaft 56. Cam disc 59 is provided with a peripheral projection 60 sequentially engageable with the operating plungers

61 of the microswitches to thereby open same responsive to rotation of shaft 56.

One terminal of motor 54 is connected by a wire 62 to supply wire 32. The other terminal of the motor is connected to one terminal of each of the microswitches 58, as by wires 63. The remaining terminals of the respective microswitches are connected by wires 64 to the stationary contacts 65 of a rotary selector switch 66 having the rotatable switch pole 67. Pole 67 is connected to the remaining supply wire 34. When pole 67 is engaged with a selected contact 65, motor 54 will be energized until its energizing circuit is interrupted by the opening of the microswitch 58 connected in series with the selected contact 65. As shown in FIGURE 3, this occurs when the lug 60 engages the operating plunger 61 of the last-named microswitch. Therefore, a selected stop arm 57 may be positioned over head 39 by engaging switch pole 67 with a corresponding stationary contact 65.

The switch assembly 66 may be remotely located and the wires 64 and 62 may be incorporated in a cable leading to the location of said switch assembly. Switch assembly 66 may be either manually operated or may be operated by any suitable timing or programming means to provide timed or programmed changes in the volume of the reagent dispensed by the burette apparatus.

While the typical apparatus illustrated herein employs six different stop arm heights, obviously any desired number of stop arms may be employed, with a corresponding number of microswitches 58 and associated servo circuit branches, with a selecting switch 66 having a corresponding number of stop selection contacts 65. Any suitable programming means 70 may be employed to operate the selecting switch pole 67.

While a specific embodiment of an improved fluid pressure-operated burette system has been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A burette device comprising a syringe cylinder, outlet conduit means, a fluid inlet, a three-way valve connected between said cylinder and said outlet conduit means and fluid inlet, said three-way valve connecting said fluid inlet to said cylinder in a first position and connecting said cylinder to said outlet conduit means in a second position, plunger means in said cylinder, a pressure-vacuum source having respective pressure and vacuum connections, a working fluid line connected to the cylinder above said plunger means, a fluid pressure-operated actuator operatively connected to said three-way valve, means to communicatively connect said vacuum connection to said working fluid line responsive to the operation of said three-way valve to said first position, whereby to elevate the plunger means in the cylinder and draw fluid into the cylinder, and means to communicatively connect said pressure connection to said working fluid line responsive to the operation of said three-way valve to said second position, whereby to depress the plunger means in the cylinder and discharge fluid from the cylinder through said outlet conduit means, and wherein the means to connect the vacuum connection and the pressure connection to the working fluid line comprises an electromagnetically operated selector valve and means to alternately energize and deenergize said selector valve responsive to the operation of said fluid pressure-operated actuator.

2. The burette device of claim 1, and wherein said plunger means comprises a pair of axially spaced pistons and a piston rod rigidly connecting said space pistons.

3. The burette device of claim 1, and wherein the means to operate the three-way valve includes means gearingly coupling said actuator to said three-way valve.

4. The burette device of claim 2, and adjustable stop

5

means located above the top end of said piston rod engageable thereby to limit the elevation of said plunger means.

5. The burette device of claim 4, and wherein said adjustable stop means comprises a rotary member mounted parallel to said piston rod and having a plurality of angularly and vertically spaced outwardly projecting stop elements of sufficient radial length to overlie the top end of the piston rod.

6. The burette device of claim 5, and a drive motor connected to said rotary member.

7. A burette device comprising a syringe cylinder, reciprocable plunger means in said cylinder, an abutment element on said plunger means, means to admit fluid into the cylinder when the plunger means is elevated and to discharge fluid from the cylinder when the plunger means is depressed, and adjustable stop means located above said abutment element engageable thereby to limit elevation of said plunger means, said adjustable stop means comprising a rotary member mounted parallel to said plunger means and having a plurality of angularly and vertically spaced outwardly projecting stop elements of sufficient radial length to overlie said abutment element, a drive motor connected to said rotary member, remote selector switch means, servo switch means actuated by said motor, a source of current, and circuit means connecting said source of current to said motor through said selector switch means and said servo switch means.

8. The burette device of claim 7, and wherein said servo switch means includes a projection mounted on said rotary member and a stationary switch operated by said last-named projection when said rotary member is in a predetermined rotated position with a stop element thereof overlying said abutment element.

9. A burette device comprising a syringe cylinder, outlet conduit means, a fluid inlet, a three-way valve connected between said cylinder and said outlet conduit means and fluid inlet, said three-way valve connecting said fluid inlet to said cylinder in a first position and connecting said cylinder to said outlet conduit means in a second

6

position, plunger means in said cylinder, a pressure-vacuum source having respective pressure and vacuum connections, a working fluid line connected to the cylinder above said plunger means, means to operate said three-way valve, means to communicatively connect said vacuum connection to said working fluid line responsive to the operation of said three-way valve to said first position, whereby the elevate the plunger means in the cylinder and draw fluid into the cylinder, means to communicatively connect said pressure connection to said working fluid line responsive to the operation of said three-way valve to said second position, whereby to depress the plunger means in the cylinder and discharge fluid from the cylinder through said outlet conduit means, said means to operate the three-way valve comprising a fluid pressure-operated actuator, means coupling said actuator to said three-way valve, a fluid pressure source, an electromagnetic control valve connected between said fluid pressure source and said fluid pressure-operated actuator, a source of current, circuit means including a control switch connecting said source of current to said electromagnetic control valve, and a further switch responsive to said actuator to reset said burette device.

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