

### [54] METERING APPARATUS

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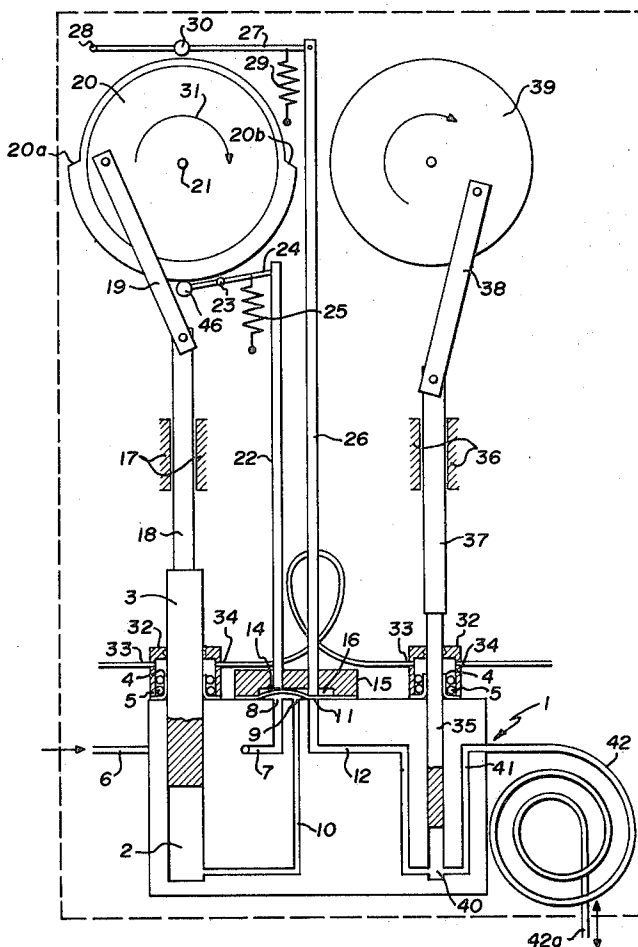
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### [57] ABSTRACT

A device for metering a measured amount of a liquid medium, particularly a corrosive liquid medium, which comprises a corrosion resistant piston means, a fluid receiving chamber operably associated with said piston means and adapted with a suction and delivery valve arrangement, whereby a measured sample is automatically provided, is described.

6 Claims, 2 Drawing Figures





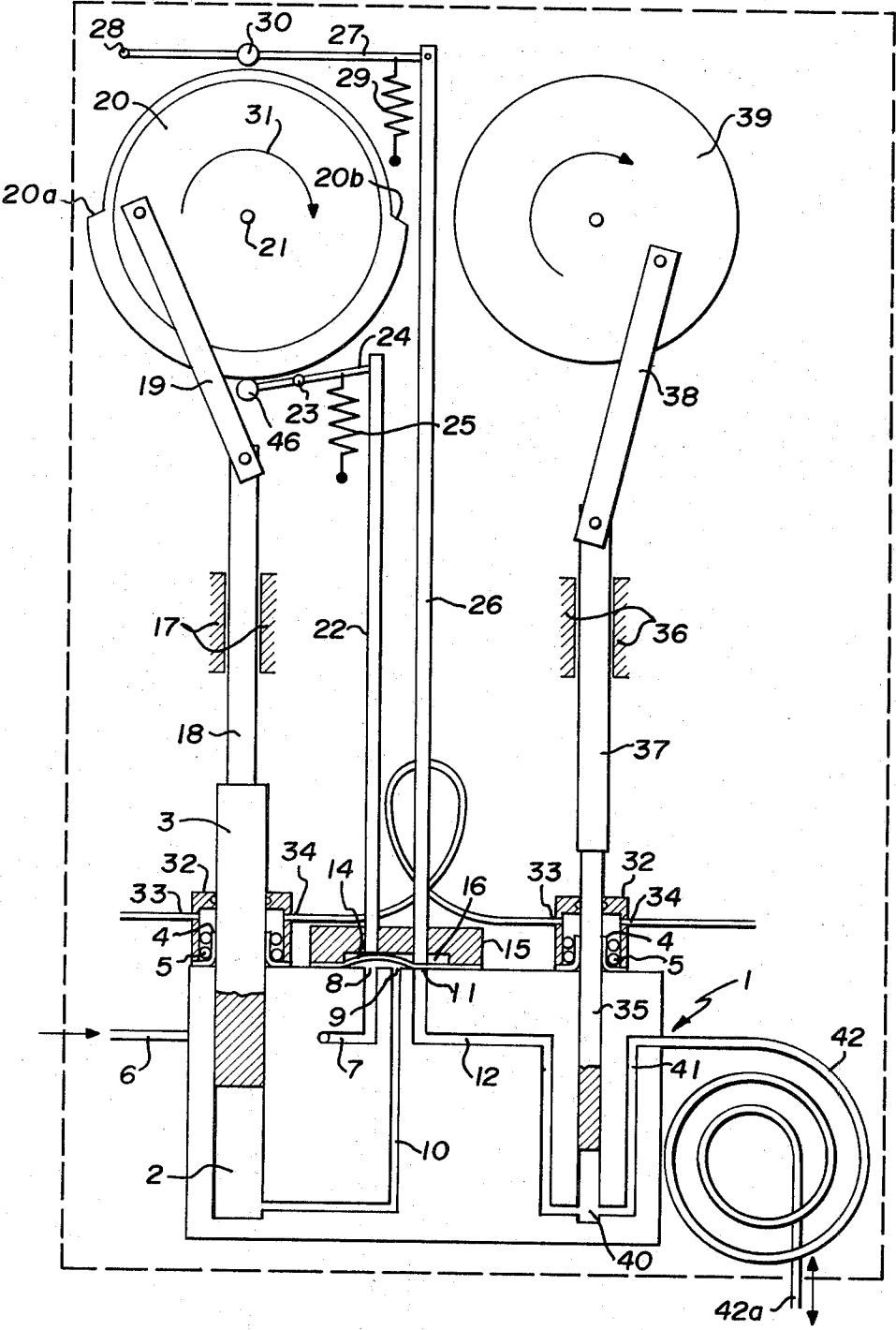


FIG. 2

## METERING APPARATUS

## BRIEF SUMMARY OF THE INVENTION

The invention relates to a metering pump comprising a chemically inert pump body member having a bore formed therein, a delivery piston means operably positioned in said bore, a fluid receiving chamber associated with said pump body member, a portion of said fluid receiving chamber being defined by a wall comprising a part of said pump body member, another portion of said fluid receiving chamber being defined by the inner surface of a flexible member or diaphragm, portions of said flexible member or diaphragm being selectively movable, one end of an inlet conduit means, one end of a connecting conduit means and one end of an outlet conduit means opening into said fluid receiving chamber, the other end of said connecting conduit means being operably associated with said bore, the said flexible member or diaphragm having a first stoppering portion in one position of the flexible member or diaphragm adapted to overlie said inlet or suction conduit, and a second stoppering portion in another position of the flexible member portion adapted to overlie said outlet or delivery conduit, a first operating or actuating member secured to said flexible member or diaphragm and adapted to move said first stoppering portion between positions, whereby said one end of said inlet or suction conduit means is opened or closed, a second operating or actuating member secured to said flexible member or diaphragm and adapted to move said second stoppering portion between positions, whereby one end of said outlet or delivery conduit means is opened or closed, actuating means operably connected to said delivery piston means and said first and second actuating members whereby the first stoppering portion is in the open position and the second stoppering portion is in the closed position on the suction stroke of the piston means and the first stoppering portion is in the closed position and the second stoppering portion is in the open position on the pressure or delivery stroke of the piston means.

In another aspect, the invention relates to a sealing collar or cup seal means disposed around a delivery piston which comprises a fluid-tight housing or casing, a sealing collar or cup seal associated with said housing or casing and in partial contact with said delivery piston, ring means associated with said sealing collar or cup seal to hold the latter in position against said piston, whereby said housing or casing and said sealing collar or cup seal defines a fluid-retaining chamber having an opening in contact with said piston, an inflow conduit and an outflow conduit operably connected to said fluid-retaining chamber.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a metering pump apparatus especially suitable for supplying corrosive media. The metering pump comprises a pump body member which possesses or defines at least one bore for receiving a delivery piston adapted for reciprocating movement along its vertical axis, at least one independent suction and delivery valve system or means, a crank mechanism or means connected to said piston and adapted with a control member, said crank mechanism with its rotation controls the actuating or operating members of the suction and delivery valve. The suction and delivery valve means is controlled automati-

cally in conjunction with the movement of said piston.

The dosage, sampling or metering pumps which generally find use for the measurement of liquids in the microliter region can be employed, for example, for the rapid and precise withdrawal and transfer of liquid specimens for analysis or reagent solutions for analysis. Existing pumps, however, have the disadvantage of having metallic parts which are attacked on contact with corrosive media and, moreover, blockage failures or drag faults occur on transfer. Also, the sealing collars or cup seals on the pumps now used commercially develop leaks with prolonged non-use of the pump due to evaporation of the solvent and the accompanying crystallization.

The present invention avoids these disadvantages by virtue of the fact that the pump body member is formed or constructed as an integral block of chemically inert material which defines three ducts or conduits, each having an end or opening, preferably in one plane, and the other end or opening respectively, joined to a suction duct or inlet conduit, to a delivery piston bore through a connecting duct or conduit and to a delivery duct or outlet conduit, the three duct ends or conduit openings being covered by a flexible, chemically resistant member or diaphragm which operably joins the ends or openings of the three ducts or conduits and, in the region of the opening of the suction and delivery ducts, can in each case be pressed against the corresponding duct end or opening by an actuating or operating means, at least actuating or operating means disposed in the region of the suction duct end or opening being firmly connected with the side of the flexible, chemically resistant diaphragm which faces away from the duct end or opening.

Conveniently, the pump body can be formed, for example, as a practically square-shaped polytetrafluoroethylene block and can be equipped with a glass piston.

The delivery piston is preferably sealed relative to the appropriate or corresponding bore of the pump body member by means of a flexible collar or cup seal which is pressed elastically or resiliently thrust against the piston surface, the said collar or cup being disposed in a fluid-tight housing or casing provided with an inlet means and an outlet means and containing a fluid or liquid such as water.

Preferably, the diaphragm or flexible member is constructed of polytetrafluoroethylene and its edge is clamped by a capping attachment or member which possesses a recess in the region or zone of the three duct ends or openings on the surface of the pump body member and two bores for the said actuating members in its upper wall.

In order that the invention may be more fully understood, two embodiments in accordance therewith will now be described by way of examples with reference to the accompanying drawings in which:

FIG. 1 is a vertical section of a dosage pump utilizable for measuring analysis samples and reagent solutions; and

FIG. 2 is a vertical section of an embodiment having two feed-pistons which allows for the intake of a liquid with subsequent expulsion and rinsing by means of a second liquid.

The metering pump illustrated in FIG. 1, omitting unessential details, comprises a pump body member 1 formed of a square-shaped polytetrafluoroethylene

block. A bore 2 defined by the pump body 1, forms the cylinder space for receiving glass piston 3 which is slidably supported therein. The gap existing between delivery piston 3 and the edge of bore 2 is sealed by means of a polytetrafluoroethylene collar or cup seal 4 which is pressed or thrust against the piston surface by elastic O-rings 5. A suction line 6 connected to a supply source of the liquid to be drawn in, measured and delivered continues in suction duct or intake conduit 7 extending through the pump body member 1 and then opening at 8 on the upper boundary surface of the pump body member 1. In the immediate vicinity of opening or exit point 8 there opens at 9 a second duct or connecting conduit 10 which starts from the lower section of the pump piston bore 2 and is connected thereto. On the same plane with the two duct ends or openings 8 and 9 there is situated at 11 a third duct or outlet conduit 12 which is connected to or communicates with delivery line 13.

The three duct ends or openings 8, 9 and 11 disposed in one plane are covered by polytetrafluoroethylene, flexible member or diaphragm 14, the periphery of which is pressed or thrust in a fluid-tight manner against the surface of the pump body 1 by capping attachment 15. Capping attachment 15, which can be constructed, for example, of brass, acrylic resin or the like, possesses in the middle region of its inner surface turned towards the outer surface of flexible member or diaphragm 14 a recess 16.

Glass piston 3 is rigidly connected with piston rod 18, which is slidably guided along its vertical axis in support or bearing 17. On the upper portion of piston rod 18 there is pivoted one end of connecting rod 19. The opposite end of connecting rod 19 is rotatably connected or joined to control disc 20. Control disc 20, fixed rigidly along its horizontal axis to axle or shaft 21 to rotate and be driven uniformly on axle or shaft 21 by a power source means, thereby driving piston 3 by means of connecting rod 19 and piston rod 18.

On the surface of flexible member or diaphragm 14 there is fixed as, for example, by gluing in the region of suction duct end or opening 8 actuating or operating rod 22 which, in turn, is articulately or operably connected or hinged with lever 24 and is swivel-mounted or pivotable about a horizontal shaft 23. A roller 46 supported at the free end of lever 24 is maintained by spring 25 in constant contact with the specially shaped boundary or circumferential surface of control disc 20.

A second actuating or operating rod 26 also projects or extends through capping attachment or member 15 into recess 16, where it rests loosely above the duct end or opening 11 on the flexible member or diaphragm 14 and presses or thrusts the latter — in the operating position drawn — against duct end or opening 11. Also, actuating or operating rod 26 is articulately or operably connected or hinged to lever 27 which can be swiveled or pivoted about horizontal shaft 28. A spring 29 acting on lever 27 holds roller 30, rotatably supported on the lever, in constant contact with the specially shaped boundary or circumferential surface of control disc 20.

The metering pump or measuring apparatus described above works as follows:

During the upward movement of glass piston 3, which corresponds to the rotation of control disc 20 in the direction of the arrow 31, suction duct end or opening 8 is maintained in the open position by actuating or operating rod 22. In this way, the liquid to be measured

and delivered flows from suction line 6 through the suction duct or inlet conduit 7, ends or openings 8 and 9 and duct or connecting conduit 10 into the bore 2 of the pump body member. As soon as glass piston 3 has reached its top dead-center, the control edge 20a of the control disc 20 encounters or strikes the guide roller 30 and raises rod 26 thus causing duct end or opening 9 to open while the guide roller 46 rolls off the control edge or band 20b and in so doing presses rod 22 slightly in a downward direction so that the suction duct end or opening 8 is closed. During the downward stroke of the piston 3 which then follows, the liquid contained in bore 2 is driven out of or displaced from the latter by the downward-sliding piston 3 and conducted or supplied via duct or connecting conduit 10, duct ends or openings 9 and 11 as well as duct or outlet conduit 12 to supply line 13.

Of particular significance in this context is the fact that during the whole procedure, the liquid to be delivered comes into contact exclusively with material which is resistant to chemicals, that is, glass, polytetrafluoroethylene or the like. Thus, the metering pump described hereinabove is absolutely corrosion-free and possesses an exceptionally low susceptibility to operating difficulties or failures.

Depending on the composition of the solution to be delivered, there can take place in the region of the sealing collar or cup seal 4, at the wetted surface of the piston, an evaporation of the solvent as well as an undesired crystallization. In order to avoid this, sealing collar or cup seal 4 is surrounded by a housing or casing 32 which is sealed by means of an O-ring against the reciprocating glass piston 3 which moves along its vertical axis. A certain amount of fluid or water is retained inside housing 32. Housing or casing 32 is provided with two line-connections, an inflow or feed line 33 and an outflow or discharge line 34, so that the liquid filling of the housing or casing can be replaced from time to time as required. A strong dilution of the solution is hereby produced and the undesired crystallization is hindered or avoided at the sensitive sliding-points of the piston.

A variant of the metering pump described above is shown diagrammatically in FIG. 2. The reference symbols used in FIG. 1 are also used here for the corresponding parts. The method of operating this pump embodiment does not differ fundamentally from the embodiment already described, so that all that has been said with reference to FIG. 1 also applies to the embodiment illustrated in FIG. 2. On the other hand, in the metering pump shown in FIG. 2, there is provided a second piston 35, slidably supported in pump body member 1, coupled by means of piston rod 37, guided vertically in the support or bearing member 36, and a connecting rod 38 with a crank disc 39 adapted with a power source means.

Delivery duct or outlet conduit 12 opens or merges into bore 40, while a delivery duct 41 issuing from the latter is connected to a helical tube 42.

This twin-piston metering pump embodiment is provided in the event that initially a first liquid is to be drawn in, measured and conveyed, and the corresponding line is subsequently to be rinsed or flushed with a second liquid in order to avoid blockage failures or drag faults. For this purpose, delivery line 6 is joined to a rinsing or flushing medium source, while the pipette tip 42a of the spiral tube 42 dips into the liquid sample

or specimen. With the upward stroke of piston 35, a certain amount of sample or specimen is drawn into the pipette tip 42a, while delivery piston 3 simultaneously suctions the rinsing agent into bore 2. With the downward stroke of the two pistons 3 and 35, the sample or specimen is first expelled from the spiral tube, whereupon the spiral tube, including the pipette tip, is washed with the rinsing or flushing medium flowing after.

The sealing collar or cup seal 4 which seals delivery piston 3 together with the diaphragm 14 may be constructed as an integral part or member.

We claim:

1. A metering pump comprising a chemically inert pump body having a bore formed therein, a piston operably positioned in said bore, a fluid receiving chamber associated with said pump body, a portion of said fluid receiving chamber being defined by a wall comprising a part of said pump body, another portion of said fluid receiving chamber being defined by the inner surface of a flexible member, portions of said flexible member being selectively movable, one end of an inlet conduit means, a connecting conduit means and an outlet conduit means opening into said fluid receiving chamber, the other end of said connecting conduit means being operably associated with said bore, the said flexible member having a first stoppering portion in one position of the flexible member adapted to overlie said inlet conduit, and a second stoppering portion in another position of the flexible member adapted to overlie said outlet conduit, a first actuating member secured to said flexible member and adapted to move said first stoppering portion between positions, whereby said one end of said inlet conduit means is opened or closed, a second actuating member secured to said flexible member and adapted to move said second stoppering portion between positions, whereby said one end of said outlet conduit means is opened or closed, actuating means comprising a control disc having an irregular boundary surface, and power source means for moving the control disc, said actuating means operationally connected to said piston means and said first and second actuating members whereby the first stoppering portion opens and the second stoppering portion closes on the suction stroke of the piston

means and the first stoppering portion closes and the second stoppering portion opens on the pressure stroke of the piston means, and a second pump comprising a second bore formed in the pump body and a second piston operably positioned in said second bore, coupled via a piston rod means, guided vertically in a support means, a connecting rod means with a second crank disc adapted with a second power source means, is operably connected to the outlet conduit and has a helical conduit connected to said second bore.

2. A metering pump in accordance with claim 1, wherein the pump body is formed of a polytetrafluoroethylene block and wherein the piston is a glass piston.

3. A metering pump in accordance with claim 2, wherein the first and second actuating members are articulated levers held in active contact with the boundary surface of the control disc by a spring.

4. A metering pump in accordance with claim 3, wherein the piston is sealed opposite the bore by a sealing collar pressed elastically against the piston which comprises a flexible collar member disposed in a fluid-tight housing, whereby said housing and said flexible collar define a fluid-retaining chamber having an opening in contact with said piston, an inflow conduit and an outflow conduit operably connected to said fluid-retaining chamber.

5. A metering pump in accordance with claim 4, wherein the flexible member is formed of polytetrafluoroethylene and is maintained against the pump body by an attachment means possessing a recess in the region of the opening of the inlet conduit means, connecting conduit means and outlet conduit means, and adapted in its upper wall with two borings for the first and second actuating members.

6. A metering pump in accordance with claim 5, wherein a second pump comprising a second bore formed in the pump body and a second piston operably positioned in said second bore, coupled via a piston rod means, guided vertically in a support means, a connecting rod means with a second crank disc adapted with a second power source means, is operably connected to the outlet conduit and has a helical conduit connected to said second bore.

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