United States Patent

Sanz et al.

[15] **3,684,409**

[45] **Aug. 15, 1972**

[54] **DISTRIBUTOR PUMP**

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[22] Filed: **Aug. 19, 1970**

[21] Appl. No.: **27,290**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 849,078, Aug. 11, 1969, Pat. No. 3,572,977.

[52] **U.S. Cl.**.....**417/519,** 417/360

[51] **Int. Cl.**.....**F04b 7/00,** F04b 17/00, F04b 35/00

[58] **Field of Search**.....417/360, 518, 519, 900

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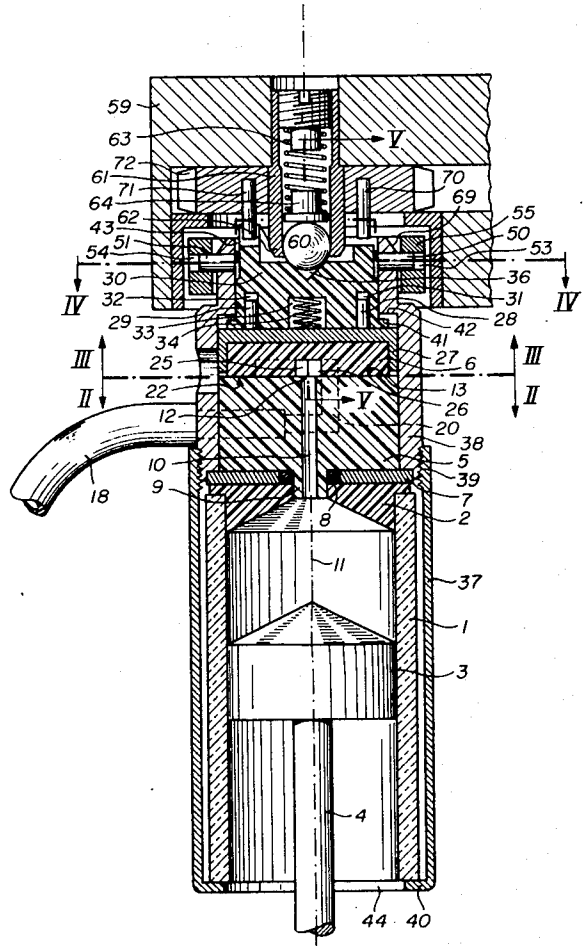
Primary Examiner—Robert M. Walker

Attorney—G. W. F. Simmons and Gerry J. Elman

[57] **ABSTRACT**

A distributor pump with two ports having a rotary valve switching mechanism and either a syringe type piston or a constant displacement piston. The valve can be either a continually rotating valve or a valve with reciprocal arcuate motion. A rotary bleed needle is provided to prime the pump. The valve mechanism and the pump are connected to a valve actuating mechanism by a positive locking arrangement.

28 Claims, 10 Drawing Figures



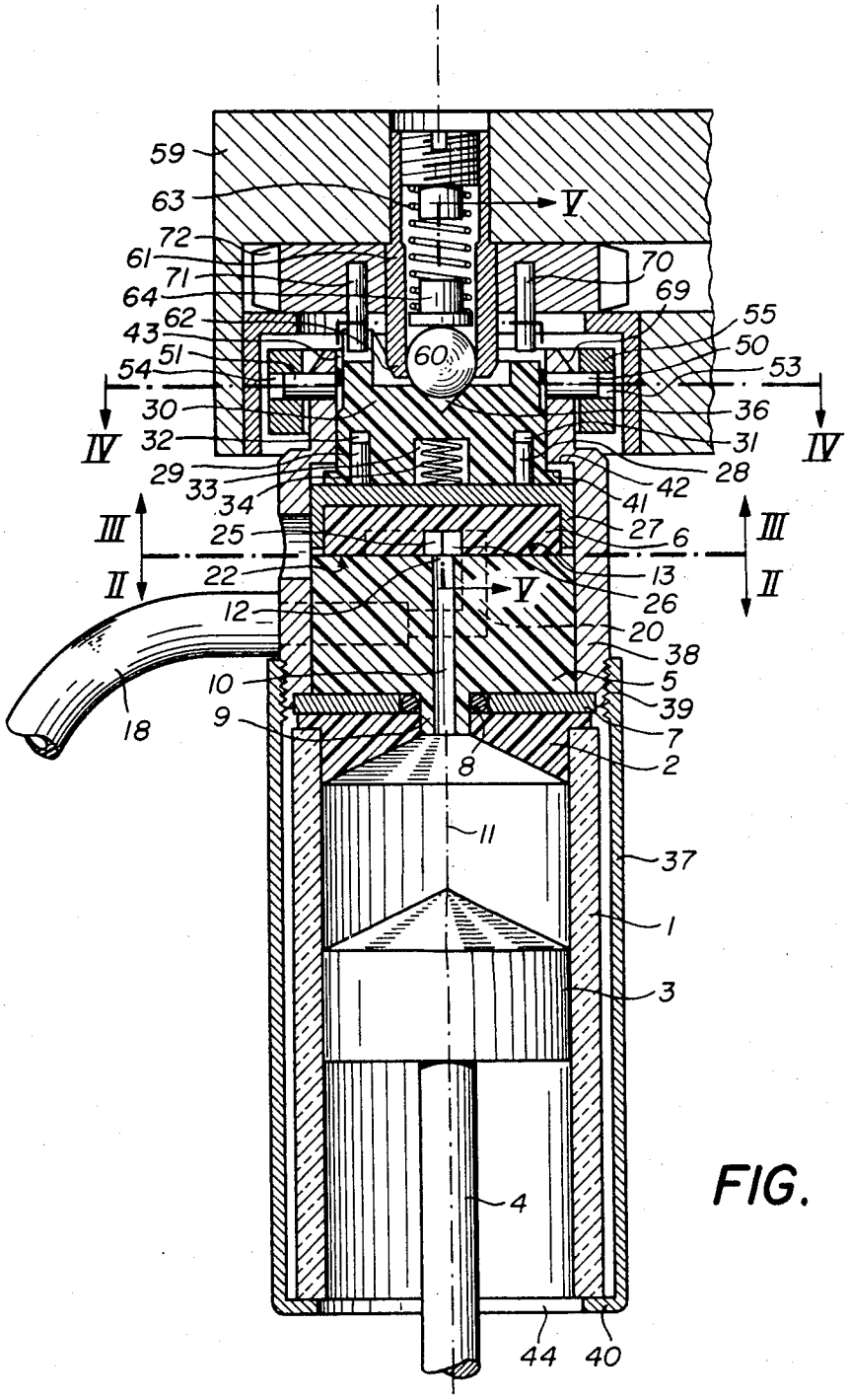

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FIG. 1

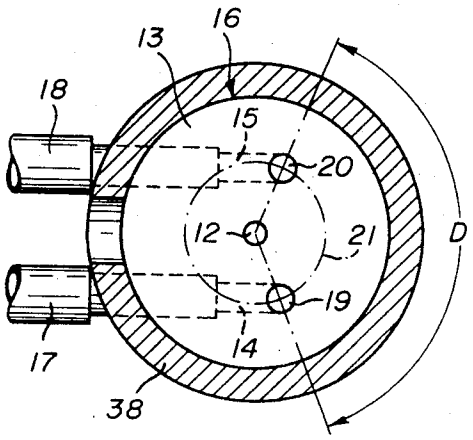


FIG. 2

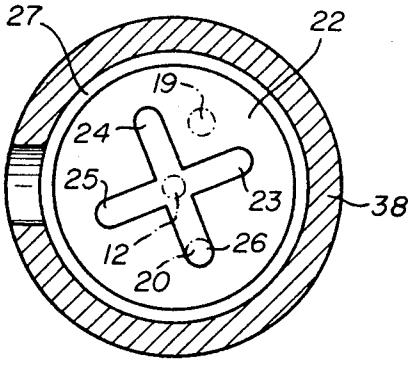


FIG. 3

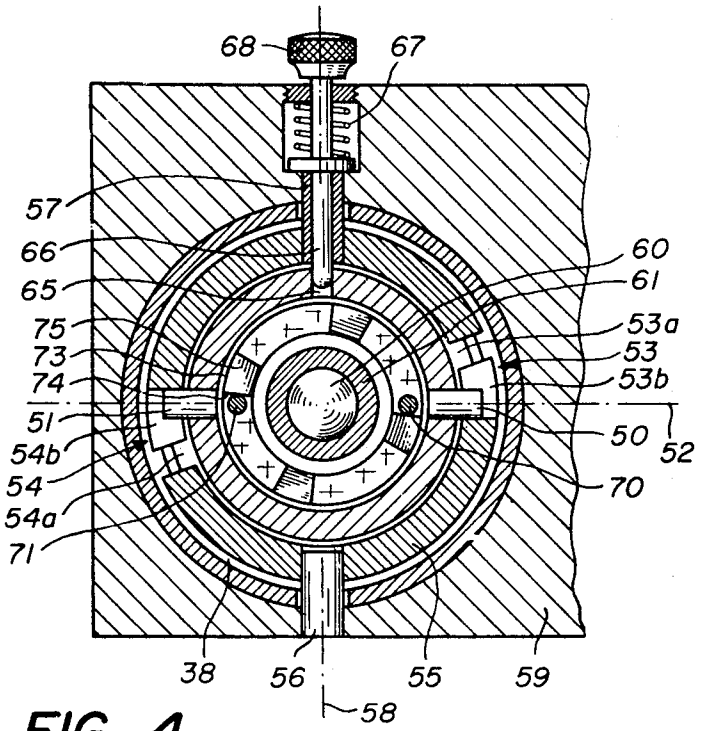

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FIG. 4

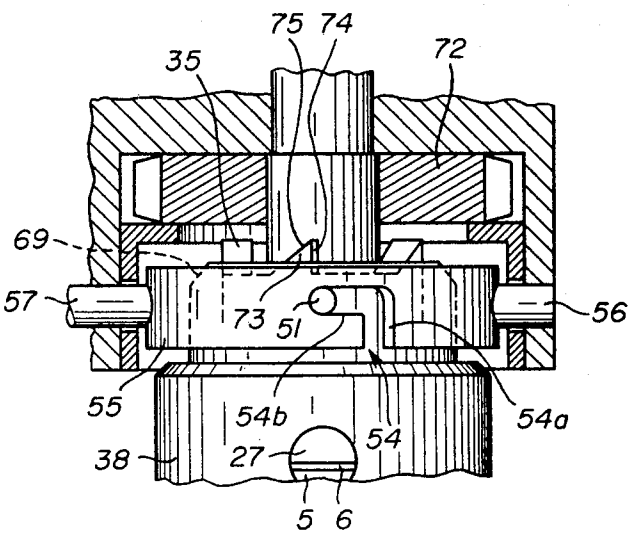

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FIG. 5

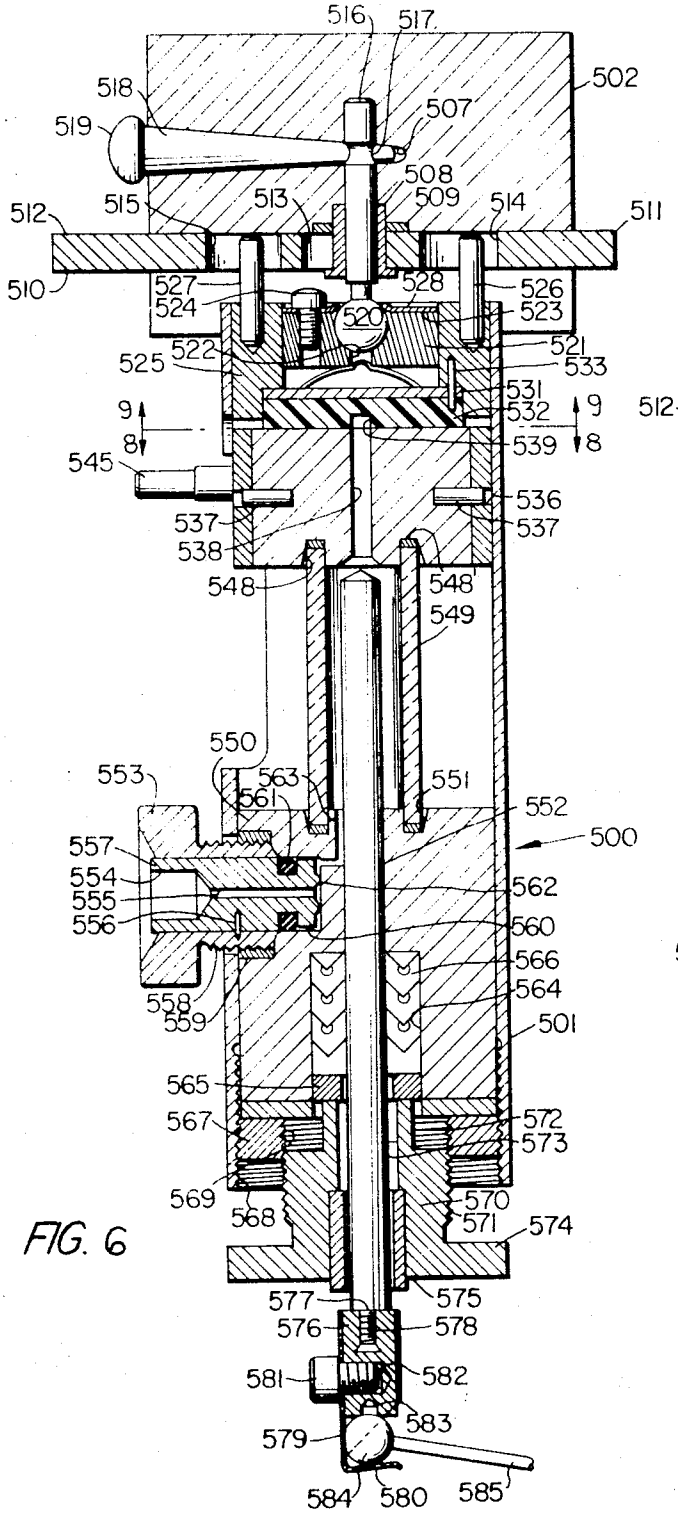


FIG. 6

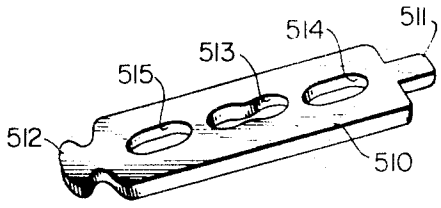


FIG. 10

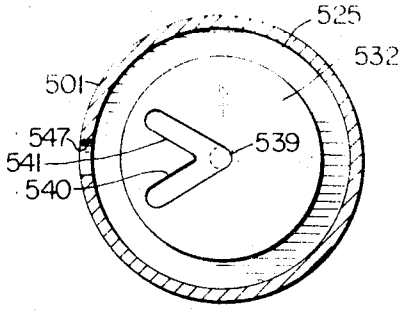


FIG. 9

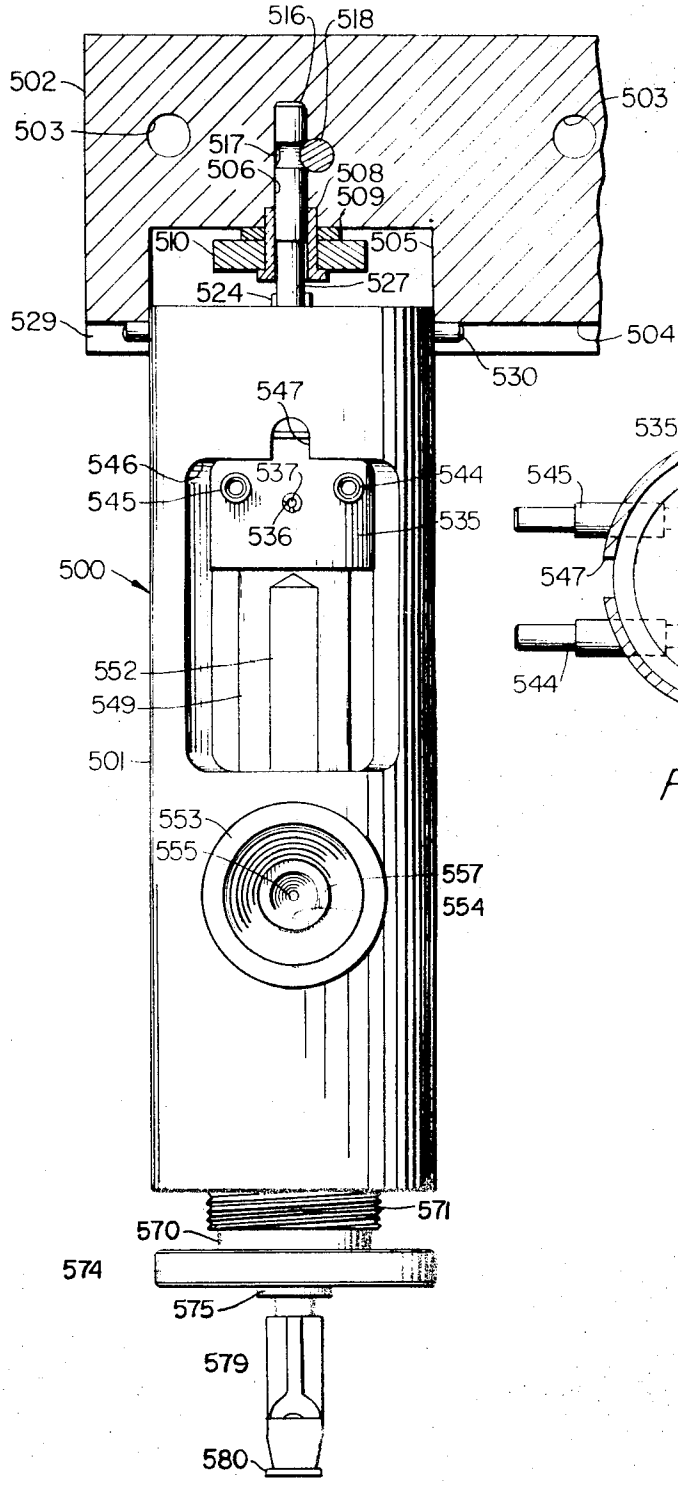

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FIG. 7

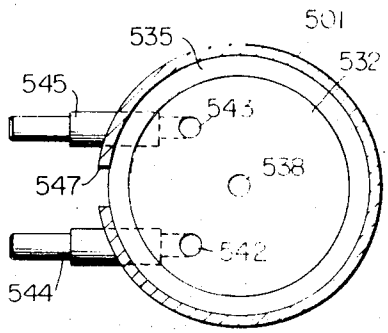

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FIG. 8

DISTRIBUTOR PUMP

This is a continuation-in-part of application Ser. No. 849,078, filed Aug. 11, 1969, now U.S. Pat. No. 3,572,977, in the U. S. Patent Office.

The present invention relates to a distributor pump intended to be mounted in a frame of an apparatus, one embodiment thereof comprising a piston syringe, a distribution valve having a fixed seat and a rotary frontal valve element, a driving member for said element, securing means permitting the whole to be made fast with the frame and locking means to prevent the pump from becoming accidentally detached from the frame. Another embodiment employs a positive displacement piston and a reciprocating rotary valve.

Piston syringes associates with distribution valves having rotative frontal valve elements are encountered in certain apparatus where a fluid is required to be aspirated, during a first stroke of the piston through a first pipe, and then during the subsequent stroke of the piston through a second pipe, the switch from the first to the second pipe being effected by the rotary valve of which the valve element performs a rotation synchronized with the reciprocating movement of the piston. In most cases the valve has a rotary frontal valve element, by which it is to be understood that the operative surface of the element which cooperates with the operative surface of the seat is perpendicular to the axis of rotation of the latter, such operative surface carrying link channels capable of putting into communication peripheral orifices which are provided on the operative surface of the seat and which are arranged in a circle around this axis of rotation with a central orifice centered on this axis. The central orifice constitutes the end of a principal channel which communicates with the part of the syringe situated ahead of the piston, while the peripheral orifices constitute the ends of auxiliary channels which open out on to the lateral surface of the seat where they are connected to pipes, generally flexible, conveying fluid to be moved by the piston.

One example of such pumps and valves are distributor and metering apparatus used in chemical analytical laboratories, and in particular those which are intended to divide up into metered samples, substances to be analyzed or to be subjected to a reaction. Such distributing and metering apparatus are particularly used in bio-chemical laboratories where they are used for haematological analyses. The pumps which are fitted to such apparatus and the associated distribution valves require frequent cleaning and those which are used in bio-chemical analytical apparatus require sterilization. With the known apparatus, this cleaning and sterilization requires a separate dismantling firstly of the pump, and secondly of the valve and also requires the re-assembly and repositioning of these members. The necessity for this dismantling and reassembly interrupts the rate of utilization of the apparatus and becomes the source of accidents due both to errors of assembly and to errors in matching parts. Apart form the risks of breakage, there are also the disadvantages associated with defects in the fluidtight sealing caused by badly matched parts.

The distributor pump of the present invention obviates the disadvantages of the known apparatus and enables easy and rapid removal and replacement, and consequently the exchange, both of the syringe itself and the distribution valve associated with it. According

to the invention, the syringe, the valve seat, the valve element and the driving member are arranged in series one after the other, along a common axis coinciding with the axis of movement of the piston and constituting the axis of rotation of the valve element and are maintained assembled in a common mounting comprising a body and a cap, said body having at its base an opening for the passage of the piston rod and said cap being provided at its upper part with an opening for the passage of the end of said driving member.

In one embodiment the securing means comprises a pair of radial studs fixed to said cap and arranged symmetrically at the ends of a straight line perpendicular to the common axis, said studs being adapted to engage, when the pump is fixed to the frame, in a pair of right angled slots provided at diametrically opposed positions in a ring pivotally mounted on the frame by means of two trunnions arranged on a diameter orthogonal to that of the slots, whereby said ring constitutes a Cardan ring to which the common mounting is attached to the bayonet fitting formed by the studs and right angled slots, the locking means comprising a longitudinal slot formed in the lateral external wall of the cap and adapted to cooperate, when the pump is fixed to the frame, with a radial pin sliding within one of the trunnions and subjected to the action of a resilient member tending to cause it to project towards the said common axis, the pin preventing rotation of the cap relative to the ring, and means for effecting, when desired, release of the rod from the slot when the pump is to be detached from the frame.

It is an object of this invention to provide an improved distributor pump and valving mechanism.

It is a further object of this invention to provide an improved positive displacement piston pump.

It is a still further object of this invention to provide an improved reciprocal rotary valve for a distributor pump.

It is a further object of this invention to provide interchangeable units of varying capacity which themselves may be easily disassembled to change the cylinder size and piston placement.

The accompanying drawings represent, by way of example, various embodiments of a pump according to the present invention.

FIG. 1 is a longitudinal section view of one embodiment of the pump.

FIGS. 2 and 3 are lateral sectional views along the lines II—II, and III—III, respectively of FIG. 1.

FIG. 4 is a cross sectional view taken along the line IV—IV of FIG. 1.

FIG. 5 is a side view, in partial section along the line V—V of FIG. 1.

FIG. 6 is a longitudinal section view of an alternate design embodiment of the pump.

FIG. 7 is a front view of the pump shown in FIG. 6 showing the valve actuating mechanism in section.

FIG. 8 is a sectional view taken along line 8—8 of FIG. 6.

FIG. 9 is a sectional view taken along line 9—9 of FIG. 6.

FIG. 10 is a perspective view of the valve switching member.

The distributor pump shown in FIG. 1 comprises a syringe constituted by a cylinder 1 closed at its upper

end by a plug 2 and a piston 3 secured to one end of a rod 4. The plug 2 is surmounted by a distribution valve comprising a seat 5 which cooperates with a rotary valve element 6. A washer 7 and a sealing ring 8 are interposed between the plug 2 and the seat 5 and the latter terminates in a connector 9 which extends through the plug 2. A principal channel 10, coaxial with the axis 11 along which the piston 3 moves, traverses seat 5 and connects the end of the connector 9, i.e. the base of the syringe, to a central orifice 12 provided in the operative surface 13 of the seat. The latter is, in addition, formed with two auxiliary channels 14 and 15 which open out on to its lateral wall 16, and which, by passing at the side of the principal channel 10, connect the flexible ducts 17 and 18 with peripheral orifices 19 and 20 provided on the operative surface 13. These peripheral orifices lie on a circle 21 (FIG. 2) concentric with the central orifice 12 and for reasons which will appear below, their angular distance D amounts to three-eighth of a circle, i.e. 135°. The valve element 6 is formed on its operative face 22 with four link channels 23, 24, 25, 26 arranged in star form at 90° to one another and adapted to put orifice 12 of seat 5 in communication with one or the other of the peripheral orifices 19, 20. The valve element 6 which is preferably made of a hard plastic material, for example Kel-F (Registered Trade Mark for polytetra-fluoroethylene) is force-fitted into a socket 27 carrying two pins 28, 29; the latter extend into two corresponding sockets 31, 32 provided in a member 30 constituting a driving member. The valve element 6 is thus angularly rigid with member 30. The latter has, at its lower end, a mounting 33 in which is lodged a spring 34, and, at its upper end, a crenelated crown 35 surrounding an axial cavity 36.

The cylinder 1, plug 2, washer 7, joint 8, seat 5, valve element 6 and driving member 30 are held in a mounting comprising a body 37 and a cap 38 which are assembled by screwing by means of a screw thread 39; the lower end of the cylinder 1 abuts against the base 40 of the body 37, the base being formed with an opening 44 for the passage of the rod 4 of piston 3, and the driving member 30 is held by a shoulder 41 cooperating with an internal shoulder 42 provided in cap 38 in order to prevent the driving member from escaping through the opening 43 in the cap. The only elements which are accessible through this opening are the crenelated crown 35 and the axial cavity 36. The effect of spring 34 is to exert on valve element 6 an axial force pressing the latter against seat 5 in order to ensure fluidtightness between these members.

The pump further comprises securing means constituted by two radial studs 50, 51, (FIG. 4) located on opposite sides of the upper end of the cap 38 along a transverse axis 52 and cooperating with slots 53, 54 at right angles formed at diametrically opposed positions in a ring 55. The latter itself pivots around two radial trunnions 56, 57 arranged along a transverse orthogonal axis 58 on the diameter on which are placed the slots 53, 54. The trunnions 56, 57 are themselves fitted in the frame 59 of the apparatus. This arrangement thus provides a Cardan joint (due to the pivoting ring 55) having a bayonet fitting (due to studs 50, 51 and slots 53, 54). When the pump is in position, the axial cavity 36 cooperates with a resilient axially acting push-member having a spherical head constituted by a ball 60 set into a tubular socket 61, the lower edge 62 of which is constricted to prevent the ball from escaping. A spring 63 causes the latter, through the intermediary of an abutment 64, to project out of socket 61 and to urge it with force against the bottom of the axial cavity 36, thereby urging valve element 6 against seat 5. This push-member assists in ensuring, when the pump is in position, fluidtightness between the seat and the element of the valve by pressing them one against the other more strongly than the spring 34 (for this reason, in FIG. 1, shoulder 41 is spacially separated from shoulder 42). When piston 3 transports the fluid, there may develop in the latter, especially when a liquid, high pressures which may induce leaks between the seat and the valve element, despite the presence of spring 34 which is dimensioned only to ensure fluidtightness when the pump is detached from the frame, i.e. when piston 3 is not in operation.

The base of socket 3 may advantageously be given a conical form, so that resilient push-member also ensures alignment of the assembly.

Finally, the apparatus comprises locking means for preventing, upon accidental rotation of the mounting constituted by body 37 and cap 38, the radial studs 50, 51 from becoming disengaged from the right-angled slots 53, 54. These locking means comprises a longitudinal slot 64 (FIG. 4) with which cooperates a locking pin 66 which extends through one of the trunnions, in this case trunnion 57, and which is subjected to the action of spring 67 which causes it to project towards the interior of ring 55. It is only when the end of this pin is voluntarily retracted, by pulling on a button 68, that the mounting can be released to rotate in such a way as to disengage the radial studs 50, 51 from the right-angled slots 53,54 thus enabling the distributor pump itself to be removed. In order to avoid the necessity of manipulating this button 68 when the pump is being mounted in position, the upper end of cap 38 comprises a conical part 69 the inclination of which is so chosen that the pin 66 can be pushed back when studs 50, 51 are engaged in the longitudinal portions 53*a*, 54*a* of slots 53, 54 and that its end will fall by itself into slot 65 when these studs abut against the base of the peripheral portions 53*b*, 54*b* of these slots.

The crenelated crown 35 of the driving member 30 is arranged so that its merlons cooperate with driving pins 70, 71 rigid with a driving wheel 72 which is itself put into rotation by means not shown. In order to prevent the tips of the merlons from abutting against the ends of pins 70, 71, when the pump is being mounted in position, it is advisable for each of them to have a straight edge and an oblique edge giving them a triangular form, so that the crenelated crown has a saw-toothed profile. This is shown in FIG. 5 for the merlon 73 which has a straight edge 74 and an oblique edge 75. Naturally this requires that the direction of rotation of the driving wheel 72 shall always be the same and tends to urge the driving pins against the straight edges of the merlons.

It will be seen that in the distributor pump of the invention, the syringe and the distribution valve are assembled as a unit, which due to the particular securing means, locking means and driving means adopted, is easily put into position on the apparatus, removed from

the latter and exchanged without any mechanical dismantling. This enables the unit to be sterilized as a whole and eliminates the necessity of subsequently reassembling members which have been individually sterilized. This is therefore a considerable advantage, since such reassembly is delicate and laborious if the benefit of sterilization is not to be lost.

The form of the link channels is immaterial. While the 90° cross arrangement which has been described for channels **23** to **26** implies a discontinuous rotation of the valve element **6**, and thus of the driving wheel **72**, a different arrangement, for example along an arc of a circle having the same diameter as the circle **21** of the peripheral orifices **19**, **20** with a radial median arm (as in an anchor arrangement), would enable the valve element **6** to be given a continuous movement.

The securing by means of a Cardan ring leaves the pump free to oscillate, thereby avoiding jamming, forcing and operational irregularities which would result both from defects in alignment as well as from a non-rectilinear movement of piston rod **4**. These are important advantages which render the distributor pump which has been described particularly useful in the case when it is required to manipulate with high precision very small quantities of fluid, as for example in micro-analysis apparatus.

An alternate and preferred embodiment of the distributor pump is shown in FIGS. **6–10** and is designated generally as **500**. It consists of a cylinder **501** connected to a valve actuating mechanism **502**. Valve actuating mechanism **502** has mounting holes **503** for mounting the mechanism to a power assembly (not shown) to drive the valving arrangement. The lower surface of member **502** has a longitudinal slot **504** therein for a purpose to be described. Member **502** has a cut-out area **505** for accommodating cylinder **501**. As seen in FIG. **7**, member **502** extends laterally away from cylinder **501**, the purpose being to accommodate another cylinder if a two pump operation is desired. A bore **506** extends vertically from area **505** up into member **502**. A lateral tapered bore intersects bore **506**. A sleeve **508** and a washer **509** pivotally mount a valve actuating lever **510**. Lever **510**, referring now to FIG. **10**, is an elongated member having a projection **511** for actuation by a power gear (not shown). Sleeve **508** passes through a figure eight type slot **513**. The slot is made in this configuration so that the member **510** may pivot in either end of the slot about sleeve **508**. The purpose of this arrangement is to allow an operator to pull on tab portion **512** of the member to slide the member forwards, thus disengaging projection **511** from the power assembly. Where one pushes on tab **512**, the pivot point of member **510** re-engages the power assembly due to the change in pivot axis.

Member **510** also has valve stud driving slots **514** and **515**. A shaft **516** extends into bore **506** and has a relieved section **517** to accommodate a tapered locking pin **518**. Locking pin **518** has a flattened tab portion **519** by which an operator may insert it into member **502**.

The other end of shaft **516** terminates in a jewel bearing **520** which is held in a recess **522** of circular member **521**. A flat plate member **523** having a central aperture therein for accommodating shaft **516** is secured to circular member **521** by a set screw **524**.

Member **521** is located in a circular aperture in rotary plug member **525** having valve driving studs **526**, **527** located thereon. The top of cylinder **501** is open and studs **526**, **527** engage in driving slots **514**, **515**, respectively, of member **510**.

Member **521** is attached to valve member **532** and a spring bearing plate **531** by pin **533**. When member **510** is driven reciprocally, the motion is translated to the valve member **532** to implement switching of the parts.

Member **501** does not rotate due to the action of slot **504** on pins **529**, **530** which are rigidly attached in any suitable manner to the member **501**. These pins limit the degree of entrance of member **501** in area **505**.

A spring **528** biases member **521** upwards thus forcing shaft **516** into engagement with bore **506** insuring a tight and rigid connection between member **502** and cylindrical member **501**.

The valve arrangement is shown in FIG. **9**. The base of member **532** has a central aperture **539** connected with radially extending channels **540** and **541**. The ends of these channels are adapted to alternately and respectively overlie port bores **542** and **543** (as shown in FIG. **8**) in stationary block **534**. Block **534** is fixed to a casing **535** by pins **537** and has a central bore **538** in communication with aperture **539** in valve member **532**. Port bores **543** and **542** are in communication with ports **544** and **545**, respectively, which protrude out from casing **535** through a cut-away section **546** of member **501**. Section **546**, as seen in FIG. **7**, has a notched cut-out portion **547** at the top thereof and has snap rings **536** holding pins **537** in place.

Thus it is seen that upon reciprocal rotation of member **532**, the bore **538** is alternately in communication with port **544** and port **545**.

A circular coaxial recess **548** in the base of port block member **534** receives the end of a tubular glass cylinder **549**. The opposite end of cylinder **549** is received in a like recess **551** in bleed block **550**. Gaskets, such as **548'** seal the ends of glass cylinder **549** into the recesses **548** and **551**.

Bleed block member **550** is generally cylindrical in configuration and has a central bore therein receiving positive displacement piston **552**.

A manually operated bleed and priming knob **553** extends from the front of cylinder **501** through a cut-out portion **560** therein. Knob **553** has a circular bore therein which receives a priming port member **557**. Port member **557** has a large diameter bore **554** tapering into a small diameter bore **555**. Knob **553** and port **557** are fixed together for rotation by pin **556** and knob **553** has external threads **558** which engage a threaded circular insert member **559** in area **560** of member **550**.

A channel and bore **563** extend down and out from the area enclosed by glass cylinder **549** and are in communication with the relieved area **560** in block member **550**. A circular shaped sealing projection **562** keeps the ends of port **557** away from the end surface of the relieved area **560**, and breaks the communication between bores **555** and **563**. A sealing ring **561** is located in an outer annular groove in port member **557** to prevent any leakage from occurring.

As knob **553** is rotated, the gap in the circular shaped projection rotates out of engagement with the end wall of the cut-out area **560** and bore **555** is in open commu-

nication with bore **563**. The purpose of this arrangement is to allow a small volume piston and cylinder combination (the cylinder and pistons may vary in size) to be primed. Large volume piston and cylinder combinations in some cases provide enough suction on the intake stroke so as to be essentially self-priming.

In the instances where the pump has to be primed, a hypodermic syringe (without the cannula) is inserted into the large diameter bore section **554** of the port **557** to provide suction within glass cylinder **549**.

A washer **565** is positioned directly beneath member **550** and it and member **550** are held in place by an externally threaded insert member **567**. The threads of insert member **567** engage internal threads **568** in the end of member **501** to hold the components of member **501** in place.

Insert **567** has internal threads **569** which are engaged by threads **571** of an adjustment member **570**. Adjustment member **570**, as shown in FIG. **6**, has a central bore **573** through which passes piston **552**. A reduced cylindrical portion **572** of adjustment member **570** abuts a washer **565** located at the base of a large bore **564** in the base of member **550**. Between the washer and the end wall of the bore are V-shaped compression seals **566**, their purpose being to prevent any leakage between the piston **552** and its bore in member **550**. By turning adjustment member **570**, provided with a roughened or serrated knob portion **574**, compression is brought to bear on the seals **566**. A guide sleeve **575** is located between adjustment member **570** and piston **552**.

The end of piston **552** has a reduced diameter threaded portion **578** which is received within a threaded bore **577** in support member **576**. Surrounding member **576** and attached thereto by screw **581** engaging internally threaded bore **582** is a resilient clip **579**. The body of clip **579** is C-shaped and snaps onto support member **576** as shown in FIG. **7**. An L-shaped resilient projection **580** extends downwardly from the clip body and cooperates with a relieved area **583** to maintain a jewel bearing **584** or any other suitable type of bearing. Bearing **584** is fixed on the end of a shaft **585** which, in turn, is received within a bore of a suitable crank arm such as **460**. A set screw maintains shaft **585** in position. It is understood, of course, that any type of connection between piston **552** and a reciprocating member may be used.

The materials used for the construction of the various ports of the device are typically metal, e.g. steel or aluminum. The internal portions of cylinder **501** are preferably made of plastic, as indicated by the cross-hatching in FIG. **6** but any other suitable material may be used.

Added rigidity to the bayonet-type connection between the valve actuating mechanism **502** and the cylinder **501** may be furnished if desired.

The embodiment of the device as shown in FIGS. **6–10** is designed to accommodate various size components, i.e. members **534, 535, 549, 550** and piston **552** can be replaced with various size units to increase or decrease the volume of the pump cylinder.

While two embodiments of this invention have been shown and described, it is obvious that many changes will occur to those skilled in the art within the scope of the appended claims.

What I claim is:

1. A metering and dispensing pump comprising an elongated housing, cylinder means within said housing, port-containing means adjacent said cylinder means in said housing, said port-containing means including at least two port bores, rotary valve means in said housing adjacent said port-containing means and adapted to alternately place each port bore in open communication with said cylinder means, said valve means having means adapted to connect said housing to a reciprocating powered member to reciprocally rotate said valve means, piston means within said cylinder means, and means associated with said cylinder and piston means adapted to adjustably seal the pump against leakage and to facilitate easy removal of said port-containing means and either or both said piston and cylinder means to vary the pump capacity.

2. A pump as in claim **1** wherein the piston means comprises a positive displacement piston of constant cross section, said cylinder having a larger cross section than said piston whereby said piston may be interchanged with a similar piston of different cross section.

3. A pump as in claim **2** wherein said port-containing means is a solid member having a first bore in communication with said cylinder means and said valve means whereby said cylinder means is constantly in communication with said valve means.

4. A pump as in claim **3** wherein said cylinder means includes a tube, said solid port-containing member having means receiving one end of said tube and said pump further including a second solid member on the other side of said tube and having means to receive said other end of the tube, said second solid member having a central passage slidingly occupied by said constant cross section piston and said two solid members and said piston may be replaced by similar components of a different size tube to vary the pump capacity.

5. A pump as in claim **4** wherein said means in each solid member receiving the ends of said tube consists of circular grooves in the surface of each member facing said tube, and sealing rings located in said grooves which receive the peripheral end edges of said tube.

6. A pump as in claim **4** wherein said tube is glass.

7. A pump as in claim **4** wherein said valve means is a rotatable member having a flat surface, said first solid member having a flat surface in sealing engagement with the flat surface of said valve means, said rotatable member having a generally V-shaped relieved area so positioned in said surface that the bottom of said V is in constant communication with said first bore in said first solid member, the remaining two bores in said first solid member in communication with its flat surface and so positioned thereon that as said valve surface rotates reciprocally the arms of said V alternately and respectively overlie the two ports.

8. A pump as in claim **7** wherein said rotatable valve member includes a second portion having a spring biased bayonet connection shaft for coupling the pump to a valve switching mechanism whereby said pump may be quickly disconnected and replaced by a pump of different capacity and also including valve driving members projecting beyond the end of the housing.

9. A pump as in claim **4** wherein said second solid member contains a pump priming means, said priming means adapted to place a source of suction in open communication with said cylinder means.

10. A pump as in claim 9 wherein said priming means comprises a threaded manually operable rotatable valve member, a threaded aperture in said second solid member, a first passage in said valve member, a second passage in open communication with said cylinder and said aperture, gate means on the end of said valve member adapted to place said first and second passage means in communication whereby said cylinder may either be bled or suction applied thereto.

11. A pump as in claim 3 wherein said housing has a cut-away portion and said cylinder means is visible, said port containing means having at least two projecting nipples in communication with said two port bores.

12. A combination metering and dispensing pump and valve switching mechanism comprising an elongated housing, cylindrical chamber means within said housing, port-containing means adjacent said chamber means, said port-containing means including at least two port bores, a rotary valve means in said housing adjacent said port-containing means on the side opposite from said chamber means and adapted to alternately place each port bore in open communication with said chamber means, removable piston means within said chamber means, adjustable and removable means associated with said chamber and piston means to seal said pump against leakage and to facilitate removal of said piston means, port-containing means and said chamber means, reciprocally rotating valve driving means connected to said valve means and having at least one driving study projecting up beyond the end of said housing, a pump supporting block having reciprocal lever means adapted to engage said driving stud and operate said valve means upon reciprocation thereof, and means rigidly but detachably securing said housing to said block whereby said pump may be quickly detached from said block and replaced by a pump of different capacity.

13. The combination as in claim 12 wherein said housing is tubular.

14. The combination as in claim 12 wherein said block has a connection bore therein, said means securing the pump housing to said block comprising a spring biased bayonet locking shaft, said shaft having a spherical bearing which is attached to said valve driving means, said shaft also extending into said connection bore, removable means detachably locking said shaft in said bore to facilitate quick removal of said pump, a sleeve in said block surrounding a portion of said shaft and said lever means pivotally mounted on said sleeve whereby upon rotation of said lever, the driving stud is engaged and said valve means is caused to operate.

15. The combination of claim 14 wherein said lever means has at least one slot therein engaging said driving stud and a projection is located on one end of said lever and is adapted to engage a power assembly to reciprocate said lever.

16. The combination of claim 15 wherein said lever has a figure eight shaped slot on said pivotal mounting on said sleeve whereby said lever can be moved longitudinally to disengage said lever projection from the power assembly thus leaving the valve in one position and whereby the pump can be removed and replaced by a second pump while said power assembly is operative.

17. The combination of claim 12 wherein the piston means is a positive displacement piston of constant cross section.

18. A pump as in claim 17 wherein said port-containing means is a solid member having a first bore in communication with said chamber means and said valve means whereby said chamber means is constantly in communication with said valve means.

19. A pump as in claim 18 wherein said cylindrical chamber means includes a tube, a solid port-containing member having means receiving one end of said tube and said pump further including a second solid member on the other side of said tube and having means to receive said other end of the tube, said second solid member having a central passage slidingly occupied by said constant cross section piston, the arrangement being such that said tube, two solid members and said piston can be removed and interchanged with similar components to change the pump capacity by removing said adjustable sealing means.

20. A pump as in claim 19 wherein said means in each solid member receiving the ends of said tube consists of circular grooves in the surface of each member facing said tube, and sealing rings located in said grooves which receive the peripheral end edges of said tube.

21. A pump as in claim 19 wherein said tube is glass.

22. A pump as in claim 19 wherein said valve means is a rotatable member having a flat surface, said first solid member having a flat surface in sealing engagement with the flat surface of said rotatable manner, said rotatable member having a generally V-shaped relieved area so positioned in said surface that the bottom of said V is in constant communication with said first bore in said first solid member, the remaining two bores in said first solid member are in communication with its flat surface and so positioned thereon that as said valve surface rotates reciprocally the arms of said V alternately and respectively overlie the two ports.

23. A pump as in claim 22 wherein said rotatable member includes a second portion having a spring biased bayonet connection shaft for removably coupling the pump to a valve switching mechanism and valve driving members projecting beyond the end of the housing.

24. A pump as in claim 19 wherein said second solid member contains a pump priming means, said priming means adapted to place a source of suction in open communication with said tube.

25. A pump as in claim 24 wherein said priming means comprises a threaded manually operable rotatable valve member, a threaded aperture in said second solid member, a first passage in said valve member, a second passage in open communication with said cylinder and said aperture, gate means on the end of said valve member adapted to place said first and second passage means in communication whereby said tube may either be bled or suction applied thereto.

26. The combination of a pump supporting means having a reciprocal lever means adapted to be driven by a power assembly and at least two interchangeably metering and dispensing pumps, each pump comprising an elongated housing, cylinder means within each housing, port-containing means adjacent said cylinder means in each said housing, each said port-containing

means including at least two port bores, rotary valve means in said housings adjacent said port-containing means and adapted to alternately and respectively place each post bore in open communication with its respective cylinder means, each of said valve means having means adapted to connect its respective housing to said reciprocating lever means to reciprocally rotate each said valve means, piston means within each said cylinder means and quick disconnect means associated with each said pump for securing it to said pump supporting means, said pumps being of different volumetric capacity.

27. The combination of claim **26** wherein said pump support means comprises a block and said quick disconnect means includes a connection bore in said block and spring biased bayonet locking shafts on said pumps, said shafts having spherical bearings which are attached to said valve means, said shafts adapted to extend up into said connection bore and a removable locking means adapted to secure said shafts in said bore.

28. The combination of claim **27** wherein said shafts have annularly relieved portions, said removable locking means comprising a tapered locking pin adapted to fit within a tapered locking bore within said block, said locking bore intersecting said connection bore so that the tapered end of said pin engages in said shaft relieved portion to removably lock the pump to said block.

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