Aug. 19, 1969 W. B. KARKOW 3,461,805

RECIPROCATING PISTON METERING PUMP

Filed Feb. 26, 1968

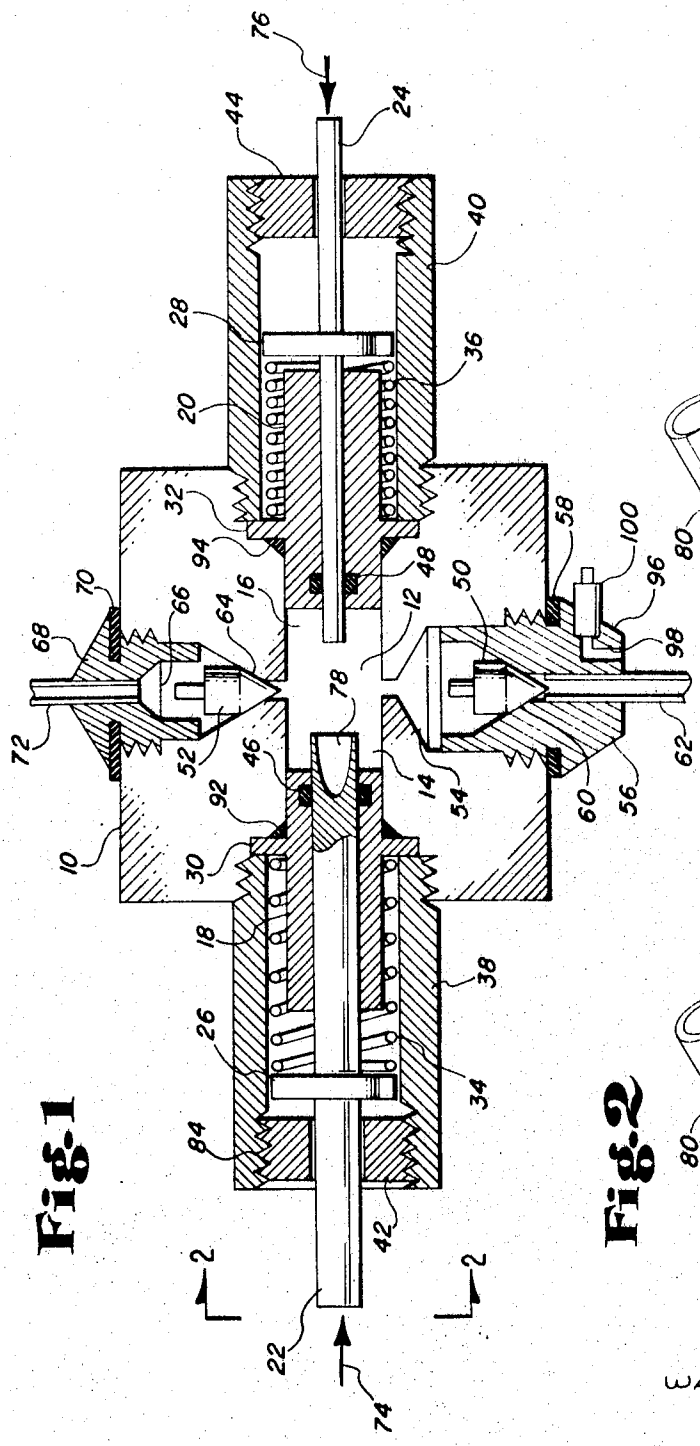

Fig. 1

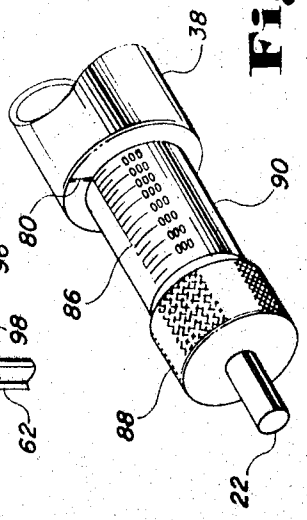

Fig. 3

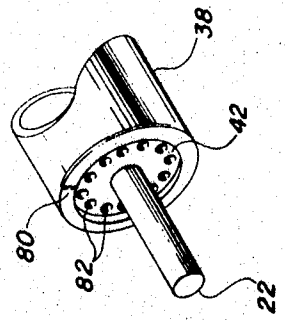

Fig. 2

WALDEMAR B. KARKOW
INVENTOR.

BY Jacque L. Meister
ATTY.

United States Patent Office 3,461,805 Patented Aug. 19, 1969

3,461,805

RECIPROCATING PISTON METERING PUMP

Waldemar B. Karkow, Yorkville, Ill., assignor to Photo Instrument Tooling Company, Yorkville, Ill., a corporation of Illinois

Filed Feb. 26, 1968, Ser. No. 708,112
Int. Cl. F04b 49/00, 3/00; B67d 5/46
U.S. Cl. 103—38 6 Claims

ABSTRACT OF THE DISCLOSURE

A piston type pump which expels fluid from a central cavity through a first check valve during the movement into the cavity of the piston and refills the central cavity through a second check valve during the withdrawal of the piston from the cavity, piston stroke length being used to control the volume of fluid displaced.

Background of the invention

The present invention relates to adjustable output metering pumps and, more particularly, to improved hydraulic pressure pumps having single acting reciprocating pistons and provided with seated type inlet and outlet valves and capable of adjustment to repeatably deliver extremely precise determinable volumes of fluid.

The pharmaceutical industry is increasingly moving from individual local pharmacy compounded drugs and remedies toward prepackaged products delivered in a form essentially completely ready for dispensing. This trend toward prepackaging is in part due to difficulties in handling and storing the newer drugs,, some of which are even radio-active. As a result, more drugs are packaged at central locations, than were formerly, thus raising a need for types of dispensing apparatus not needed in local pharmacies where high speed did not necessarily have to accompany accuracy and antiseptic procedures.

Among the types of dispensing apparatus found necessary for mass prepackaging of drugs, is means for filling ampules, syringes and vials with precisely measured quantities of various liquid forms of drugs. Since for antiseptic reasons alone it is usually desirable to remove human participation from the filling process, and since such removal is often mandatory where the human would be exposed to radio-active drugs, it becomes necessary that the dispensing apparatus be capable of very reliably dispensing exact amounts of fluid without human intervention of any kind—including monitoring.

It is accordingly a principal object of the invention to provide a new and improved metering pump capable, once adjusted, of reliably delivering a dose of exactly the required size or volume to an ampule or other package. The pump necessarily must be adjustable to admit of varying the doze size and must be so constructed that it can be repeatedly subjected to the autoclave process associated with antiseptic procedures.

In keeping with these problems and objects, the inventive pump comprises a cavity containing block fitted with one or more pistons reciprocable into and out of the cavity. The cavity has inlet and outlet passages each having a check valve therein. The piston stroke is precisely adjustable by means of a micrometer type screw which positions a piston stroke limiting stop. For a better understanding of the invention and its advantages, reference should be made to the accompanying drawing and descriptive matter in which are illustrated and described specific inventive embodiments.

In the drawings:

FIGURE 1 is a cross-sectional view of the adjustable output metering pump embodying the present invention;

FIGURE 2 is a partial perspective view in the direction of arrows 2—2 in FIGURE 1; further illustrating the stroke adjusting means; and

FIGURE 3 is a partial perspective view illustrating an alternative stroke adjusting means.

A pump body **10** comprises an interior cavity **12**. The pump body is further provided with two bored passages **14** and **16** to receive piston guides **18** and **20** respectively. Each of the piston guides contains a passage bored therethrough for a close fitting but free relationship with a piston; guide **18** having piston **22** fitted therein and guide **20**, piston **24**. Each of the pistons **22** and **24** has an enlarged diameter of collar-like appearance, **26** and **28** respectively. Between these collars and the upstanding flanges **30** and **32** of their respective guides, are positioned compression springs **34** and **36** respectively. Each spring tends to push its associated piston outwardly from the interior cavity **12**.

Piston guides **18** and **20** are each secured in position by an end cap, cap **38** for guide **18** and cap **40** for guide **20**. Each end cap is threadedly engaged into pump body **10** to press upon the flange of its associated guide and thereby retain it in position. Simultaneously the flanges **30** and **32** compress resilient sealing means, such as an O ring, **92** and **94**, into chambers at the entrance to bored passages **14** and **16**, thereby sealing the guides to the pump body.

It is a feature of the invention that each of the end caps in turn has a stroke limiting stop threadedly engaged in the outermost portion of its bore to thereby retain the associated piston and fixed the outermost limit of piston travel by blocking movement of the piston collar. Thus, by screwing the stop inward or outward, maximum travel of the piston **22** is thereby decreased and increased proportionally. Similarly, positional adjustment of stroke limiting stop **44** effects corresponding changes in the stroke of piston **24**. The manner of adjusting stops **42** and **44** is described further in connection with FIGURES 2 and 3.

To insure a tight fit of pistons **22** and **24** in their respective guides, there is provided packing ring means **46** and **48**. For embodiments constructed to date, the packing means has taken the form of a high temperature ionizing radiation resistant material with sufficient resilience to effect the required seal and has been in the form of an O ring retained in an annular groove in the bore of the piston guide. For more severe service, more such packing ring can be provided in each guide.

Cooperating with the operation of the pistons to enable pumping action are seated type inlet and outlet check valves **50** and **52**, respectively. Valve **50** is constrained to operation in a valve chamber **54** communicating with cavity **12** and formed by a drilled recess in pump body **10** and valve bonnet **56** threadedly engaged therewith. Bonnet **56** is sealed to body **10** by gasket **58**. As shown, valve **50** is maintained in aligned mating contact with the valve seat **60** of bonnet **56** by form factors, gravity and the pressure within cavity **12** exerted by pistons **22** and **24**. While this construction is preferred for its mechanical simplicity, in some embodiments a compression spring inserted between valve **50** and body **10** has been used to advantage to maintain the proper seating relationship. A suction tube **62** secured to bonnet **56** extends away from the pump and, during pump operation, is normally submerged in the supply of liquid to be pumped.

To facilitate mounting of the pump to the supply vessel and thus enhance sterility, bonnet **56** can be variously configured. As shown the outer surface **96** of bonnet **56** has been given a standard 24–40 Flask Taper to permit mating contact with the ground surface of a glass laboratory flask. Since this contact can be and often is airtight, a drilled bypass **98** for makeup air is provided in the

bonnet and microporous filter **100** is inserted therein to block the passage of micro-organisms carried with the air. Still other exterior configurations of bonnet **56**, such as a bayonet or screw shape, has proven useful.

Valve **52** operates similarly to valve **50**. However, valve seat **64** is formed in pump body **10** and valve chamber **66** is closed to the pump exterior by bonnet **68** and gasket **70**. Discharge tube **72** is shown truncated but is normally fitted at its outermost extremity with an output adapter particularly suited for filling the desired special container.

In operation the pump ejects precise increments of fluid from the discharge line **72** upon the reciprocation of either or both of pistons **22** and **24**, either individually or simultaneously in combination. As the pistons are moved in the direction of arrows **74** and **76** into the interior cavity of the pump, pressure therein increases, opening outlet valve **52** and further seating inlet valve **50**, and, a volume of fluid equal to total piston displacement is ejected from the cavity into the outlet tube **72**. Piston inward travel is limited when piston collars **26** and **28** engage their respective guides **18** and **20**.

When the driving force represented by arrows **74** and **76** is released, the pistons move outwardly in their respective guides due to the action of springs **34** and **36** until the piston collars **26** and **28** limit piston travel upon engaging stops **42** and **44**. The outward movement of the pistons lowers pressure in cavity **12** thus seating outlet valve **52**, unseating inlet valve **50**, and causing the ingestion fluid into the cavity through the supply suction tube **62** from the supply vessel.

No particular method of actuating pistons **22** and **24** is shown, since such means are generally conventional and outside the scope of this invention. Obviously however, it is desirable that the piston drive means be capable of more travel than piston maximum and, the drive means is then preferably coupled by a resilient connection of any suitable type that allows for the necessary over-travel.

For economy of operation and antiseptic reasons, it is desirable that the volume of fluid retained in the pump cavity be made as small as possible considering the maximum delivery volume. It is a feature of the invention that this matching of cavity size to maximum output volume is facilitated by providing a recess **78** in the innermost tip of piston **22**. By proportioning recess **78** to surround the top of piston **24** when either or both of pistons **22** and **24** are moved inwardly, volume of cavity **12** is minimized.

Since the inventive pump is primarily intended for the very accurate metering of various volumes of fluids, it has been found that output volume adjustment is enhanced by utilizing pistons of substantially different diameter and hence displacement. In the embodiment shown and preferred, piston **22** displaces ten times the volume of piston **24** for substantially equal axial movement.

A further inventive feature is micrometric adjustment of pump displacement and output. The means for achieving such adjustment are stops **42** and **44**. By positioning the stops through screwing them in or out of their respective caps **38** and **49** piston travel, and hence displacement, is adjusted. As best shown in FIGURE 2, cap **38** bears an index mark **80**. Cooperating therewith are numerous indicia **82** radially disposed about the face of stop **42**, one mark for each decimal increment in fluid displacement of the associated piston; e.g., if maximum piston displacement is one hundred (100) cc., threads **84** are chosen and indicia **82** disposed so that moving from one indicium **82** to the next adjacent indicium will vary displacement by one (1) cc. Stop **44** is similarly configured except that total displacement of piston **24** is normally a small fraction of that of piston **22** with a consequential corresponding reduction in the value of each indicium on the stop. It is an additional inventive feature that by using holes as indicia **82**, the use of a spanner wrench for adjusting stop position is facilitated.

Another and advantageous variation of the method for achieving micrometric adjustment of pump output is shown in FIGURE 3. As there illustrated, a conventional type of micrometer thimble **90** bearing decimal calibrations **86** is selectively adjusted relative to index mark **80**, a knurled grip **88** being provided for effecting thimble rotation. Although the variation of FIGURE 3 is advantageous in some circumstances, for economy of manufacture, the combination embodied in FIGURES 1 and 2 is preferred. However, it should be understood that further modifications and variations may be employed by those skilled in the pump art without departing from the spirit and scope of the invention.

What is claimed is:

1. A metering pump for dispensing a precise preset volume of fluid comprising

a pump body comprising an interior cavity, inlet and outlet valve chambers opening upon said cavity and communicating with the exterior of said body, and at least one stepped diameter piston operating passage opening upon said cavity and extending to the exterior of said body,

piston means positioned for reciprocation in said cylinder operating passage, said piston having a collar affixed thereto,

spring means acting upon said collar to thereby urge said piston outwardly from said cavity,

adjustably positioned stop means for limiting the outward travel of said piston means, and

inlet and outlet check valves positioned in said inlet and outlet valve chambers respectively, whereby reciprocation of said piston between contact with said stop and said stepped diameter ejects fluid from said cavity through said outlet valve equal in volume to piston displacement.

2. A metering pump in accord with claim **1** wherein said piston means comprises two horizontally opposed pistons of substantially different diameter, the larger diameter piston having a recess in its working surface proportioned to surround the tip of the smaller piston when both pistons are operated simultaneously.

3. A metering pump in accord with claim **1** wherein said inlet valve chamber is closed by bonnet means, said bonnet means comprising an outer surface having a standard flask taper and makeup air bypass means including filter means.

4. A metering pump in accord with claim **1** wherein said stepped diameter piston operating passage comprises flanged piston guide means inserted in said pump body.

5. A metering pump in accord with claim **4** wherein said adjustably positioned stop means comprises cap means secured to said valve body and a stop threadedly engaged with said cap.

6. A metering pump in accord with claim **4** wherein said adjustably positioned stop means comprises cap means secured to said valve body and a micrometer thimble type stop threadedly engaged with said stop.

References Cited

UNITED STATES PATENTS

3,116,648	1/1964	Arenhold	103—38 X
3,258,175	6/1966	Taylor	222—380
3,327,900	6/1967	Goda	222—309 X
3,343,539	9/1967	Moorhouse	222—309 X

LEONARD H. GERIN, Primary Examiner

U.S. Cl. X.R.

103—166; 184—28; 222—309, 380