Oct. 14, 1958 M. S. REYNOLDS 2,855,928

SYRINGE DEVICE FOR SUPPLYING REPEATABLE SAMPLE VOLUMES

Filed July 12, 1957 2 Sheets-Sheet 1

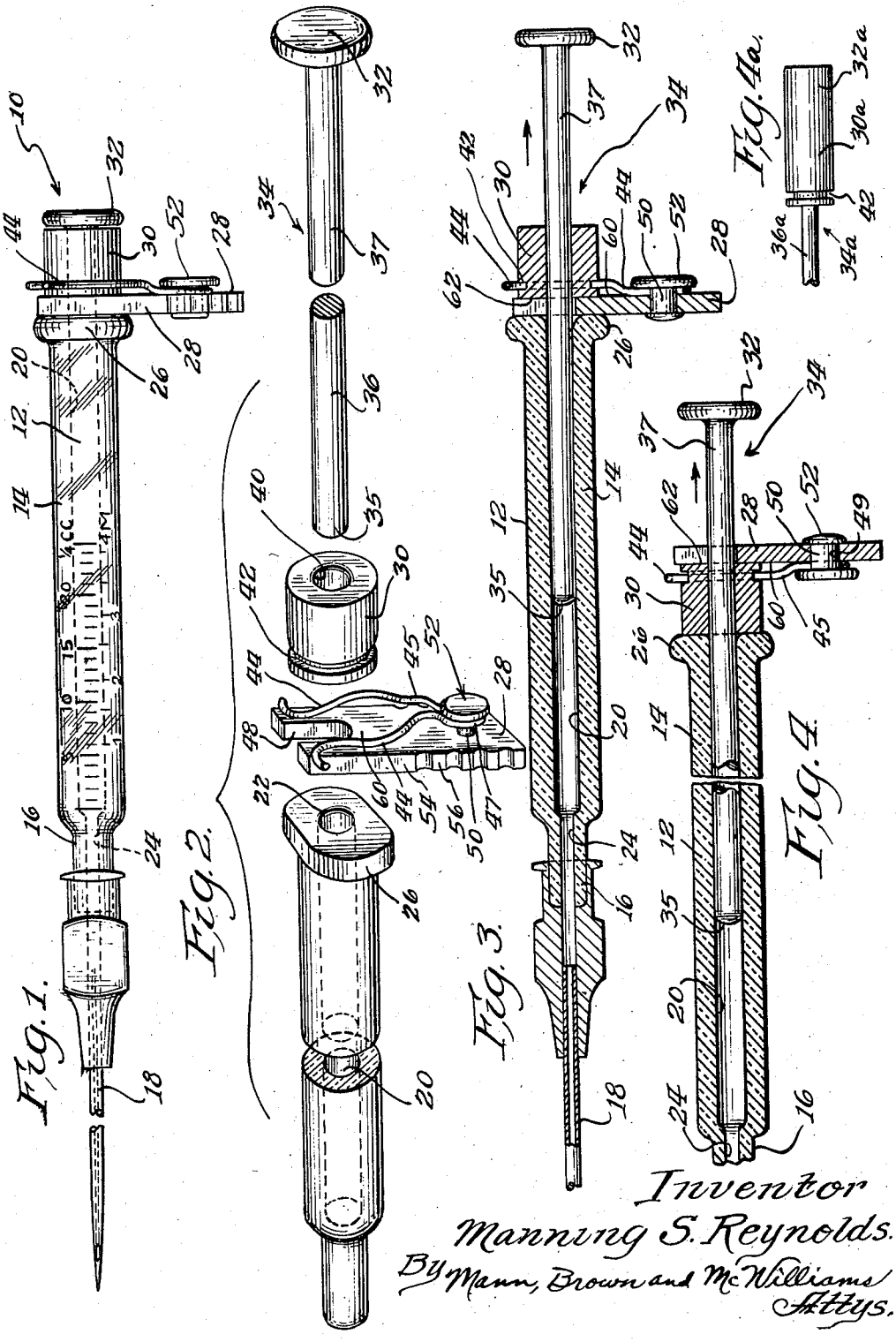


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4a.

Fig. 4.

Inventor
Manning S. Reynolds.
By Mann, Brown and McWilliams
Attys.

Oct. 14, 1958 M. S. REYNOLDS 2,855,928

SYRINGE DEVICE FOR SUPPLYING REPEATABLE SAMPLE VOLUMES

Filed July 12, 1957 2 Sheets-Sheet 2

Fig. 5.

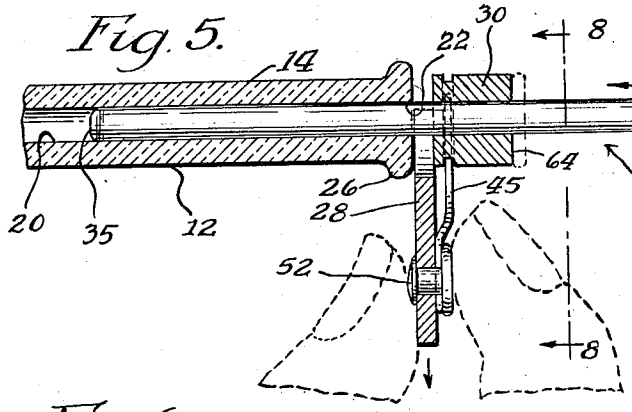


Fig. 6.

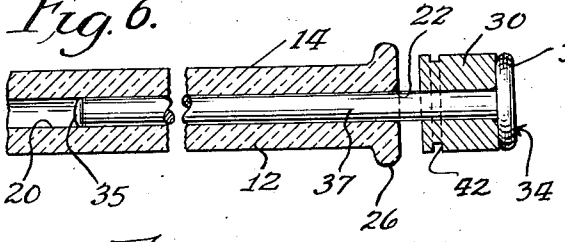


Fig. 7.

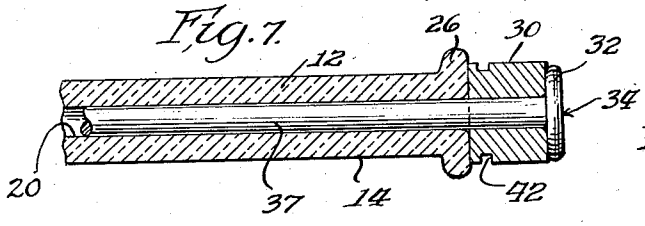


Fig. 10.

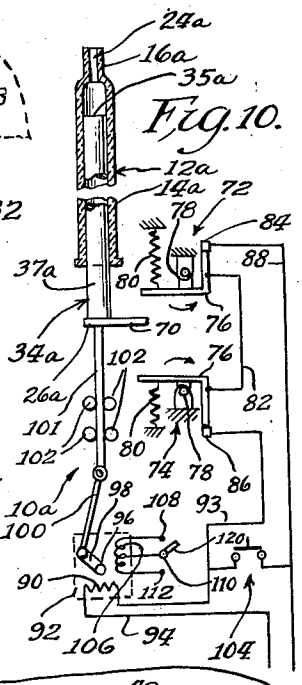


Fig. 8.

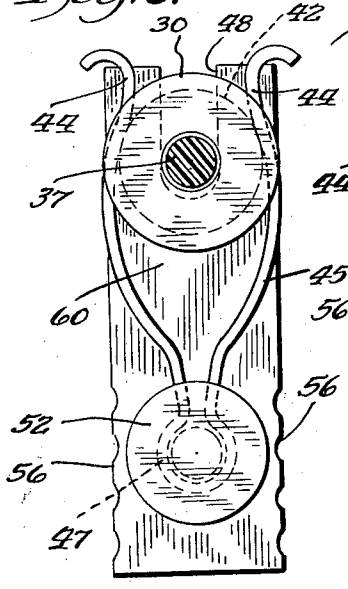
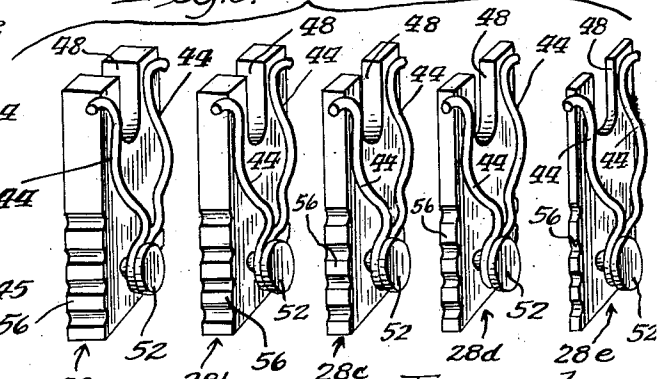


Fig. 9.



Inventor

Manning S. Reynolds.

By Mann, Brown and McWilliams

Attys.

United States Patent Office 2,855,928 Patented Oct. 14, 1958

2,855,928

SYRINGE DEVICE FOR SUPPLYING REPEATABLE SAMPLE VOLUMES

Manning S. Reynolds, Chicago, Ill., assignor to Central Scientific Co., a corporation of Illinois

Application July 12, 1957, Serial No. 671,634

3 Claims. (Cl. 128—218)

My invention relates to a method and device for obtaining and supplying repeatable sample fluid volumes, and more particularly, to a method and device for repeatably injecting test volumes of fluid into a testing area or space.

The need frequently arises in scientific work for repeatedly testing substantially identical volumes of gases or liquids. The volumes required may be different for different experiments, but for any particular experiment, it is desirable to repeatedly provide substantially equal volumes of a gas or liquid.

A principal object of my invention is to provide a syringe device and method that conveniently supplies repeated volumes of fluid.

A further object of my invention is to provide a syringe instrument set which makes it possible for the experimenter to supply repeated volumes of a test fluid, and yet which permits him to supply the volume desired for a particular series of tests.

Another object of the invention is to provide a repeatable volume syringe device which is composed of few and simple parts, which is economical of manufacture, convenient in use, and readily adapted to a wide variety of applications.

Other objects, uses, and advantages will be obvious or become apparent from a consideration of the following detailed description and the accompanying application drawings.

In the drawings:

Figure 1 is a side elevational view of one embodiment of my invention;

Figure 2 is an exploded perspective view of the elements making up the embodiment of the invention shown in Figure 1;

Figure 3 is a longitudinal cross-sectional view through the device of Figure 1, illustrating the manner in which the syringe is initially charged;

Figure 4 is a view similar to that of Figure 3, but illustrating a slightly modified arrangement;

Figure 4*a* is a fragmental elevational view illustrating a further modified arrangement;

Figure 5 is a view similar to that of Figure 3, but illustrating an intermediate step in the operation of the device for providing the desired volume of fluid that is to be repeatedly injected by the syringe;

Figure 6 is a view similar to that of Figure 5, illustrating the syringe positioned to inject the desired volume of fluid that is to be repeated;

Figure 7 is a view similar to that of Figure 6 but illustrating the syringe after the desired volume has been injected;

Figure 8 is an enlarged cross-sectional view along line 8—8 of Figure 5;

Figure 9 is a perspective view of a set of spacers or repeatable volume providing elements that accompany and form a part of my syringe device; and

Figure 10 is a diagrammatic plan view illustrating another embodiment of my invention.

Reference numeral **10** of Figure 1 generally indicates a mechanical control type syringe device, or syringe type device, in which the principles of my invention have been incorporated, while reference numeral **10***a* of Figure 10 generally indicates an electrical control type syringe device. The device **10** comprises a transparent (though it need not be transparent) tubular cylinder **12** of a conventional syringe shape including an enlarged portion **14** and a reduced portion **16**, the latter receiving a conventional tubular needle **18** or other fluid conduit means as may seem desirable or necessary under the circumstances. The cylinder **12** may be formed of glass or any appropriate material and includes a cylindrical chamber **20** terminating at an opening **22** at one end thereof and a passageway **24** at the other end thereof that leads to the tubular needle **18**. The cylinder **12** is formed with a collar **26** against which cooperate (in the embodiment of Figures 1–4 and 5–9) a selectable spacer **28**, a permanent cylindrical spacer element **30**, and annular knob or handle **32** of syringe piston **34**. Piston **34** of the embodiments of Figures 1–9 includes an elongate rod like element **36** which is integrally united with a stop means in the form of handle or knob **32**. Element **36** serves the function of both a piston and a piston rod, it integrally uniting piston portion **35** and piston rod portion **37**. The element **36** is received in chamber **20** and may be sufficiently long in length to substantially fill the available space in chamber **20** when only spacer **30** separates handle **32** from contact with collar **26**. The diameter of the element **36** is proportioned so that it will snugly but slidably fit within chamber **20** to provide the sealing action required in devices of this type.

The permanent cylindrical spacer element **30** is an annular member formed from any appropriate substance and is provided with centrally disposed cylindrical perforation **40** which receives the element **36**. The spacer **30** is formed with an annular groove or recess **42** to receive the spring arms **44** of spacer **28**. In the alternate arangement shown in Figure 4*a*, spacer **30***a* is made an integral part of piston **34***a*, handle **32***a* in effect being enlarged axially of the piston and formed with groove or recess **42** to receive arms **44** of spacer **28**.

Spacer **28** comprises a member having a predetermined thickness, and which, in the illustrated embodiment, is generally quadrilateral in configuration and is formed with a U-shaped slot **48** which receives the member **36**. Spring arms **44** are integrally united into a resilient spring **45** formed from any type of spring metal. Spring **45** includes a looped portion **47** that is secured about stem **50** of appropriate pin **52** which is tightly fixed in hole **49** of the spacer **28** and binds the spring **45** against pivotal movement. The sides **54** of the spacer **28** may be knurled as at **56** for ease in handling same.

As indicated in Figure 9, I prefer to provide a set of spacers for each syringe device **10**. Each spacer **28***a*, **28***b*, **28***c*, **28***d*, and **28***e* is identical to the spacer **28** except that the thickness is different. The particular spacer selected for use will depend upon its thickness, which is made equivalent to the piston displacement required to provide the desired volume of fluid. The spacers are marked with indicia indicating the volume of fluid it will provide, as for instance, .010 cc., .020 cc., etc. Of course the number of spacers in any particular set and the thicknesses selected for a set are optional.

In operation, the cylindrical spacer **30** and a spacer **28** selected to provide a desired volume of fluid are received over the member **36** in the manner indicated in Figures 1 and 3. The spring arms **44** of the spacer **28** are received in the annular groove or slot **42** of the member **30** with the surface **60** of the member **28** abutting the end **62** of the spacer **30**. This holds the spacer **28** to the spacer **30**.

To charge the syringe **10**, the piston **34** is moved to the left as far as it will go with the spacers **28** and **30** interposed between handle **32** and collar **26** (the position of Figure 1) and then the needle **18** placed in a source or container of the fluid that is to be tested. The piston **34** is then at least partially withdrawn from the cylinder (see Figure 3), which draws the fluid into the chamber **20** of the syringe through passageway **24**. At this point, it is immaterial whether or not the spacers move with the piston. After a charge has been brought into the chamber **20**, the air is expelled (if a liquid is employed) and the piston **34** is moved to the left of Figure 5 to expell excess fluid, until the spacers prohibit further movement in this direction. This positions the syringe for discharge of the desired volume of fluid that is to be repeatedly provided.

The spacer **28** is then gripped in the manner indicated in Figure 5, or by grasping the knurled portions **56** of edges **54**, and the spacer **28** withdrawn as indicated in Figure 6. The piston **34** is then forced to the left of Figure 6 to the position of Figure 7 which effects the discharge of the desired volume of fluid by bringing spacer **30** into contact with collar **26** (see Figure 7). The collar **26** and spacer **28** thus form spaced stop members along the path of operation of piston **34**.

For each test of the fluid required, the foregoing steps are repeated. This insures that the same volume of fluid is provided for each occasion that it is required.

The arrangement of Figure 4 is the same as that of Figure 3 except that the spacers **28** and **30** are in reversed positions. The embodiment of Figure 4 operates in the manner described above, however, as does the embodiment of Figure 4*a*.

Cylinder **12** may be provided with appropriate indicia as indicated in Figure 1.

The device **10***a* of Figure 10 includes a cylinder **12***a* that may be identical to the cylinder **12** of Figure 1, and thus includes an enlarged portion **14***a* in which chamber **20***a* is formed and a reduced portion **16***a* in which passageway **24***a* is formed that lead to a needle or some receiver for the repeatable volume to be supplied by device **10***a*. Cylinder **12***a* is preferably fixedly mounted in any suitable manner, as by an appropriate clamp or the like. A piston **34***a* is reciprocably mounted in chamber **20**, and includes piston portion **35***a* and piston rod portion **37***a* that terminates in flange **26***a*. Flange **26***a* includes an extension or arm **70** which operates between two spaced limit switches **72** and **74** of any appropriate type. In the embodiment illustrated, each switch is shown as including a switch arm **76** pivoted as at **78** and biased in the direction of the arrow by compression springs **80**. The switch arms **76** are electrically connected by lead **82**; they respectively engage contacts **84** and **86** under the action of springs **80**. Contact **84** is electrically connected to an appropriate source of electrical energy by lead **88** while contact **86** is connected to the stator coil **90** of appropriate shaded pole motor **92** by lead **93**. The coil **90** is connected to the source of electrical energy by lead **94**.

Motor **92** includes a shaft **96** that moves crank arm **98** to reciprocate piston **34***a* through link **100** and rod extension **101**. Appropriate rollers **102** may be provided for guiding the reciprocating action of rod extension **101**.

A push button switch **104** of any appropriate type is connected between leads **88** and **93**. Motor **92** includes pole coil **106** that is connected to contacts **108**, **110**, and **112** by appropriate leads. A switch arm **120** is pivotally connected to contact **110** for making contact with either contact **108** or **112**, depending on the direction of motor rotation that is desired. Since shaded pole motors are well known in the art, no further description of motor **92** is believed necessary, though it will be assumed that motor **92** will move piston **34***a* upwardly of Figure 10 when arm **120** closes contacts **108** and **110**, and that movement in the opposite direction is achieved by arm **120** closing contacts **110** and **112**. In any event, the showing of Figure 10 is for illustrative purposes only, and it is to be understood that any electrical arrangement which will reverse the operation of piston **34***a* on contact of the extension or arm **70** with one of the switches **72** or **74** would be satisfactory and is within the scope of the invention.

In operation, assuming that the extension or arm **70** is at the end of its injection stroke (its uppermost position), the passageway **24***a* is placed in communication with a supply of the fluid that is to be injected, arm **120** is placed in contact with contact **112**, and switch **104** is closed to actuate motor **92**. This starts movement of piston **34***a* downwardly of Figure 10, which draws fluid into the cylinder **12***a* and also closes switch **72**, which permits continued piston movement after switch **104** is released. When extension or arm **70** contacts switch arm **76** of switch **74**, switch **74** is opened which stops this downward or charging motion of piston **34***a*. Arm **120** is then moved to close contacts **108** and **110**, the passageway **24***a* placed in communication with the space into which the repeated volume is to be injected, and switch **104** again closed, which starts the ejection stroke of the piston **34***a* that provides the volume of fluid desired. Contact of the arm or extension **70** with arm **76** of switch **72** terminates the injection stroke, the above steps being repeated for each volume of fluid desired. Switch arms **76** thus form spaced stop members along the path of operation of piston **34***a*.

The spacing between arms **76** of switches **72** and **74** determines the volume of fluid that is to be repeatedly injected, and it is understood that switches **72** and **74** will in practice be mounted for adjustment of the spacing between them, though this is omitted in the showing of Figure 10 for simplicity of illustration.

While the cylinder **12***a* is shown vertically disposed in Figure 10, it will be appreciated that this showing is for illustrative purposes only, and that the syringe cylinder is capable of being used in a variety of positions.

An important advantage of my invention is that the piston and its repeatable volume defining means may be employed with a wide variety of syringes of the same nominal size. Since the piston diameters of different syringe cylinders may vary slightly for syringes of the same nominal size, it is apparent that changing syringes may change the volume of the sample that is delivered.

However, this is entirely acceptable, as the goal is repeatable volumes, not exact volumes. The goal of repeatable volumes is attained so long as the same syringe is used throughout a series of tests.

Both liquids and gases can be supplied by devices **10** and **10***a* with equal facility.

The spacers **28** may be designed to provide liquid volumes on the order of, for instance, .005 cc. up to .060 cc.; if the spacers are to be employed to provide gas samples, a larger volume range may be selected.

The foregoing description and the drawings are given merely to explain and illustrate my invention and the manner in which it may be performed, and the invention is not to be limited thereto except in so far as the appended claims are so limited since those skilled in the art who have my disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

I claim:

1. A repeatable volume syringe comprising a cylinder formed with a fluid passageway at one end thereof permitting flow of fluid into and out of the cylinder, a piston forming rod like element reciprocably mounted in said cylinder and extending outwardly of the other end of said cylinder, a handle carried by said element at its outwardly extending end, said handle limiting the movement of said element toward said passageway by engage-

ment with said other end of said cylinder, a spacer of predetermined thickness removably mounted on said element between said handle and said other end of said cylinder, and a spacer retaining member carried by said element between said handle and said other end of said cylinder, said spacer carrying a pair of resilient arms that grasp said member to retain said spacer on said element, whereby, said cylinder may be supplied with fluid by withdrawing said element away from said passageway to draw fluid into the cylinder through said passageway and then said fluid ejected to the limit permitted by said spacer, said member and said handle, by forcing said element toward said passageway until said spacer and said member cease movement by contact with said other end of said cylinder, whereupon said spacer may be removed to permit ejection of a predetermined volume of said fluid from said cylinder through said passageway based on the thickness of said spacer.

2. In a syringe device including a cylinder and a piston reciprocably mounted in the cylinder, the improvement wherein a pair of spaced stop members are provided along the path of operation of the piston which define the piston stroke length required to provide a predetermined volume of fluid ejection from the cylinder, and means for repeatably reciprocating said piston over said stroke length to draw said predetermined volume of fluid into said cylinder and eject said predetermined volume of fluid therefrom, said spaced stop members comprising a flange that is fixed with respect to said piston and a stop abutment that is fixed with respect to

the cylinder, and a spacer element removably carried by said piston and disposed between said flange and said abutment, said spacer element defining said piston stroke length, and being removed to eject said predetermined volume of fluid from the syringe.

3. In a syringe device including a cylinder and a piston reciprocably mounted in the cylinder, the improvement wherein a pair of spaced stop members are provided along the path of operation of the piston which define the piston stroke length required to provide a predetermined volume of fluid ejection from the cylinder, and power means for repeatably reciprocating said piston over said stroke length to draw said predetermined volume of fluid into said cylinder and eject said predetermined volume of fluid therefrom, said spaced stop members comprising electrical switch means connected in an electrical circuit that controls said power means, and arm means carried by said piston for movement between said switch means, and means for reversing the direction of operation of said power means on contact of said arm means with one of said switch means.

References Cited in the file of this patent

UNITED STATES PATENTS

1,649,022	Eisele	Nov. 15, 1927
2,216,354	Pletcher	Oct. 1, 1940
2,602,446	Glass	July 8, 1952
2,607,343	Sarver	Aug. 19, 1952