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MICROMETER CONTROLLED LEAK-PROOF SYRINGE

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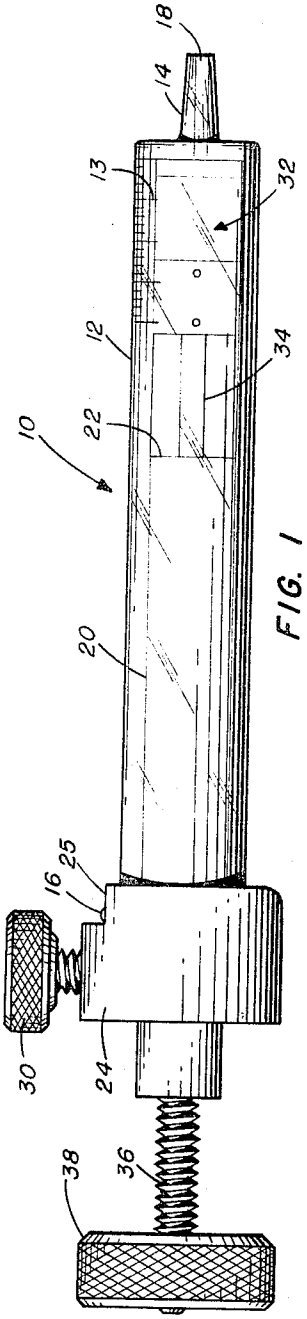

FIG. 1

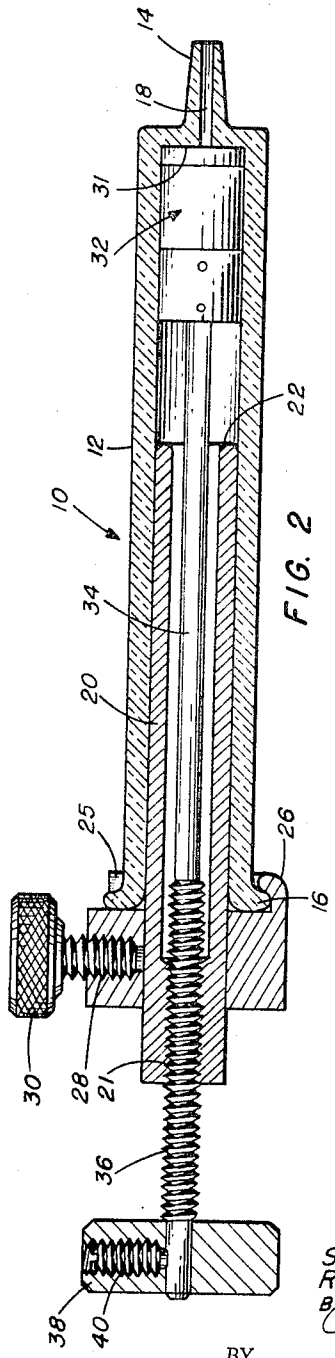

FIG. 2

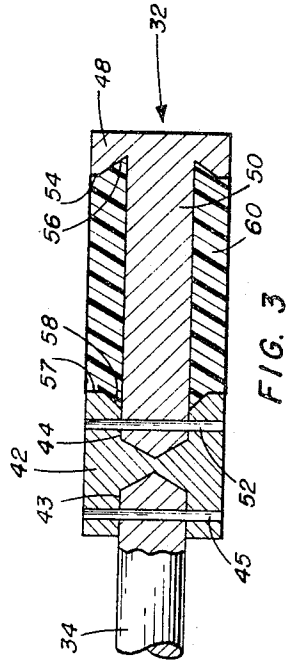

FIG. 3

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MICROMETER CONTROLLED LEAK-PROOF SYRINGE

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The present invention relates to dispensers and more particularly to a micrometer controlled leak-proof syringe.

Those concerned with the development of syringes have long recognized the need for a syringe which is absolutely leak-proof, which can handle all kinds of corrosive and non-corrosive fluids and which can dispense an exact measured quantity of fluid with extreme accuracy.

There are, in general, two different types of syringes in use at the present time. The first type, commonly referred to as a hypodermic syringe in the medical field, is comprised of a hollow tube or barrel, one end of which is open to admit a piston, and the other end of which is provided with a restricted orifice. A piston is slidably received within the open end of the barrel to provide a suction, when withdrawn during intake stroking, for introducing the fluid into the tube through the orifice and to eject the fluid therefrom during exhaust stroking when the piston is advanced inwardly toward the orifice. The second type, commonly referred to as a micrometer controlled syringe, is generally used when either an extremely high pressure is required for forcing the fluid therefrom as, for example, in a grease gun, or when an exact measured quantity of fluid must be dispensed as, for example, in a laboratory instrument. This type of syringe generally comprises an outer tube or barrel having a restricted orifice at one end and a tapped bore at the other end. A piston having a threaded stem portion is disposed within the barrel with the stem thereof threadedly engaging the tapped bore in the barrel end so that the piston may be advanced into and withdrawn from the barrel by rotation of the piston stem.

Although such prior art micrometer controlled syringes have generally served the purpose, they have not proven entirely satisfactory under all conditions of service since considerable difficulty has been experienced both in providing a positive seal between the rotatable piston and the outer barrel and in controlling, with a high degree of accuracy, the amount of fluid dispensed.

The general purpose, therefore, of the present invention is to provide a syringe which embraces all of the advantages of similarly employed prior art micrometer controlled syringes and which possesses none of the aforedescribed disadvantages. To attain this purpose, the micrometer controlled syringe of the present invention utilizes both a unique non-rotatable piston seal and a novel inner sleeve fluid measurement device.

Accordingly, an object of the present invention is the provision of a syringe which has a completely leak-proof piston seal.

Another object is to provide a syringe having a rotatable piston with a non-rotatable piston seal thereon.

Still another object is to provide a syringe which may be used with all kinds of corrosive and non-corrosive fluids.

A further object of the invention is the provision of a syringe which may be filled with, and which can dispense, an exact measured quantity of fluid.

Yet another object of the invention is the provision of a syringe which is characterized by simplicity of construction, low cost and ease of operation.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which:

FIG. 1 is an elevation view of the syringe of the present invention;

FIG. 2 is an elevation view, in section, of the syringe shown in FIG. 1; and

FIG. 3 is an enlarged fragmentary sectional view of a portion of the syringe of the present invention.

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIGS. 1 and 2 a syringe **10** comprised of an outer cylindrical barrel **12** provided with precisely calibrated volume markings **13** thereon and having a tip **14** at one end. An outwardly extending annular radial flange **16** is provided at the other end. In addition, the tip **14** is provided with a restricted orifice **18** for conducting the fluid into and out of the barrel **12**. A cylindrical sleeve **20** is coaxially disposed within the outer barrel **12** with one end thereof being provided with a tapped bore **21** while the other end **22** is open. A clamp **24** having an annular flange **26** secured around the radially extending barrel flange **18** and having a tapped bore **28** with a thumb screw **30** threadedly received therein is provided for releasably securing the sleeve **20** to the outer cylindrical barrel **12**. Alternatively, the clamp **24** may have a slot **25** provided therein so that it may be slipped over the barrel flange **18** for assembly or disassembly. A piston, indicated generally by reference character **32**, is coaxially disposed within the outer cylindrical barrel **12** between the open end of the sleeve **20** and the end **31** of the barrel **12**. The piston **32** is secured to a piston rod **34** having a threaded portion **36** for threadedly engaging the tapped bore **21** of the sleeve **20**. A knob **38** is secured to the end of the piston rod **34** by a set screw **40**.

As more clearly illustrated in FIG. 3, the piston **32** is comprised of a first cylindrical disk **42** having first and second cylindrical recesses **43**, **44** formed respectively in opposite faces thereof. The piston rod **34** is disposed within the first recess **43** and secured to the disk **42** by means of a pin **45**. A second cylindrical disk **48**, forming the forward face of the piston **32**, has an integral axially extending stem portion **50** disposed in recess **44** and secured to the first cylindrical disk by means of a pin **52**. The inside face of the second cylindrical disk **48** is provided with an annular flat surface **54** and an inverse tapered wall surface **56** joining the disk **48** to the stem portion **50** while the corresponding juxtaposed face of the first cylindrical disk **42** is provided with similar surfaces **57** and **58**, respectively. An annular seal **60** is slightly compressed and disposed within the annular frusto-conical seat formed by the disks **42**, **48** and the stem **50**.

The seal **60** is preferably fabricated from a fluorocarbon synthetic resin, e.g., tetrafluoroethylene, this type of resin commonly being known as Teflon, a registered trademark of E. I. du Pont de Nemours & Company, Incorporated, of Wilmington, Delaware. The outer barrel **12** is preferably formed of a transparent material, such as glass or the like, while the remaining parts are fabricated from either a metal, such as stainless steel, or a chemically inert plastic.

The syringe **10** of the present invention is prepared for filling by unscrewing the set screw **30** and by rotating the

knob 38 until the piston 32 abuts the open end 22 of the sleeve 20. The piston 32 and the sleeve 20 are then advanced into the barrel 12 until the piston 32 abuts the end 31 thereof. The tip 14 of the syringe 10 is then immersed in the fluid to be dispensed and the sleeve 20 and the piston 32 are partially withdrawn from the barrel 12 by pulling on the knob 38 until the desired volume of fluid, as indicated by volume markings 13, is contained in the barrel 12. The set screw 30 is then screwed into the tapped bore 28 to securely lock the sleeve 20 to the outer barrel 12, thereby insuring that the quantity of fluid contained in the barrel 12 remains constant until the fluid is dispensed by rotation of the knob 38.

As set forth hereinabove, difficulties have been encountered with prior art micrometer operated syringes in providing a positive seal between the rotating piston and the inside wall of the barrel. In the present invention, this difficulty is overcome by providing a seal which does not rotate with the piston. This is accomplished by providing a larger frictional force between the seal 60 and the inside wall of the barrel 12 than between the seal 60 and the piston 32. Since the frictional force between two relatively movable objects is proportional to the contacting surface area therebetween, the syringe of the present invention is configured so that the contacting surface area between the seal 60 and the inside of the glass barrel 12 is sufficiently larger than the total contacting surface area between the seal 60 and both the frusto-conical seat 54, 56, 57, 58 and the stem 50 so as to maintain the seal stationary with respect to the rotating piston, thereby providing a positive seal. Furthermore, since the seal is fabricated from Teflon, the syringe may be used with all corrosive and non-corrosive fluids.

There has, therefore, been described a syringe which, due to the construction of the inner sleeve 20 and the micrometer piston advancement means, can dispense an exact measured quantity of fluid with extreme accuracy and which, due to the construction of the Teflon seal assembly, provides a positive seal between the piston and the outer barrel which can be used with all types of fluids.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that many modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A micrometer controlled leak-proof syringe comprising:
- an outer cylindrical barrel having a radially extending annular flange at one end and an orifice at the other end;
- a cylindrical sleeve disposed within and coaxial with said barrel, said sleeve having a tapped bore at one end thereof;
- a clamp engaging said barrel flange and having a thumb screw disposed in a tapped aperture therein, said thumb screw normally engaging said sleeve near the tapped bore end thereof for releasably securing said sleeve to said barrel;
- a piston rod, a portion of which is coaxially disposed within said sleeve, said piston rod having a threaded lead screw portion for threadedly engaging said tapped bore in said sleeve, said piston rod having a knob secured thereto at one end;
- a piston secured to the other end of said piston rod for rotational movement therewith, said piston having an annular peripheral frusto-conical groove therein;
- seal means disposed in said groove, said seal means contacting the inside surface of said barrel; and
- means for preventing rotation of said seal relative to said barrel as said piston is rotated;

whereby, as said piston is advanced through said barrel by rotation of said piston rod, said seal does not rotate, thereby providing a positive seal between said piston and said barrel.

2. A syringe in accordance with claim 1 wherein:
- said barrel is formed of glass, said piston is formed of stainless steel and said seal is formed of Teflon.

3. A syringe in accordance with claim 2 wherein:
- said piston is comprised of first and second cylindrical disks, said second disk having an integral stem portion secured to said first disk, said first and second disks having juxtaposed annular tapered wall portions defining an annular frusto-conical seat into which said Teflon seal is disposed.

4. A syringe in accordance with claim 3 wherein:
- said seal is configured and arranged so that the contacting surface area between said seal and said barrel is sufficiently large with respect to the contacting surface area between said seal and said piston to prevent rotation of said seal as said piston rotates.

5. A micrometer controlled leak-proof syringe comprising:
- an outer barrel formed of a transparent material;
- a sleeve slidably disposed within said barrel, said sleeve extending throughout a substantial portion of the axial length of said barrel, said sleeve having a tapped bore at one end thereof;
- means releasably securing said sleeve to said barrel;
- a rotatable piston rod coaxially disposed within said barrel and threadedly engaging the tapped bore of said sleeve;
- a rotatable piston secured to said piston rod and coaxially disposed within said barrel;
- annular seal means disposed on said piston and contacting the inside surface of said barrel; and
- means to prevent rotation of said seal on said piston as said piston is rotated in said barrel.

6. A micrometer controlled syringe comprising:
- an outer barrel;
- means slidably mounted within said barrel and having a tapped bore disposed adjacent the end of said barrel;
- a piston rod disposed in said barrel and threadedly engaging said tapped bore;
- a piston secured to the end of said piston rod;
- and seal means disposed around said piston in sealing engagement with said barrel.

7. A syringe in accordance with claim 6 wherein:
- said seal means is fabricated from Teflon and is disposed in a peripheral groove in said piston.

8. A syringe in accordance with claim 6 wherein:
- said slidably mounted means comprises a cylindrical sleeve.

9. A syringe in accordance with claim 6 additionally having:
- means to prevent rotation of said seal means as said piston rod is rotated.

10. A micrometer type precision controlled leak-proof syringe comprising:
- an outer cylindrical barrel having a stepped axial bore terminated by an elongated axial orifice portion of substantially reduced bore dimensions with respect to the major portion of the bore thereof;
- a generally hollow cylindrical sleeve disposed within and coaxial with said barrel, said sleeve having a threaded bore at one end thereof;
- clamp means cooperating with the end portion of said barrel remote from said orifice portion, said clamp means being disposed to normally engage said cylindrical sleeve adjacent the threaded bore end thereof for releasably securing said sleeve against relative movement with respect to said barrel;
- a piston and piston rod member, a portion of which piston rod is coaxially disposed within said sleeve, said piston rod portion thereof having a threaded

lead screw portion for threadedly engaging said threaded bore in said sleeve and effecting linear movement of said piston portion, the piston portion thereof having a spool-like configuration comprising at least one pair of land portions, one of which land portions is secured to the other land portion thereof at the terminal end of said rod portion remote from said threaded portion;

a Teflon seal disposed on the spool portion of said piston between the land portions thereof;

said piston land portions functioning to control linear motion of said seal contemporaneously with movement of said piston and rod member while said seal is maintained in a non-rotational relationship therewith while providing for rotational movement of the piston during controlled linear motion therewith, said piston land portions each having an annular concave frusto-conical configuration and being disposed in mutually juxtaposed relationship in a manner to matingly engage said seal;

whereby, as said piston and piston rod member is advanced through said barrel by rotation of said lead screw portion of the piston rod, said seal is advanced therethrough in a non-rotatable manner, thereby providing a positive seal between said piston spool portion and said barrel.

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