

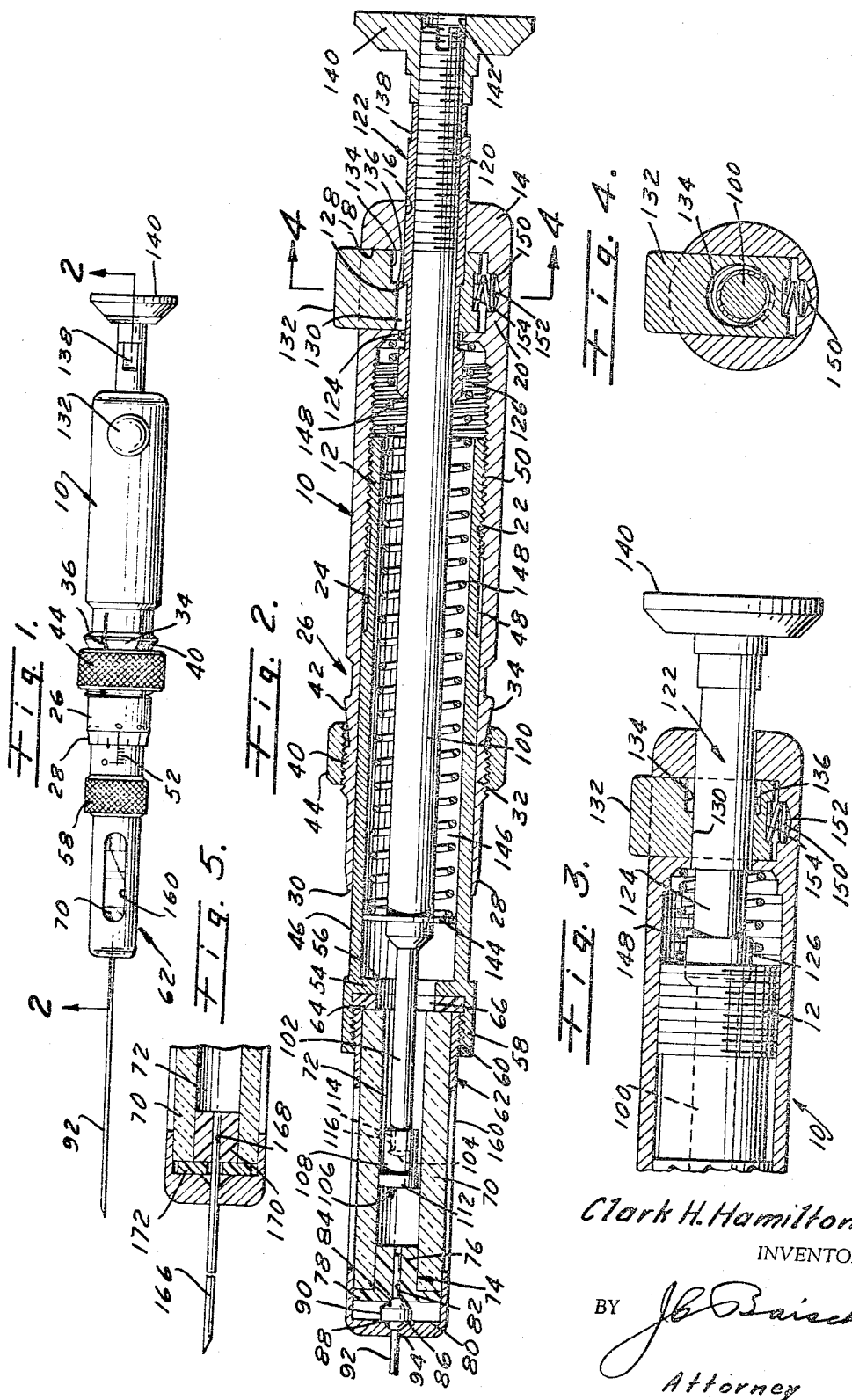
Aug. 8, 1967

C. H. HAMILTON

3,334,788

SYRINGE FOR CHROMATOGRAPHIC ANALYSES

Filed Aug. 13, 1963



3,334,788

SYRINGE FOR CHROMATOGRAPHIC ANALYSES

Clark H. Hamilton, 707 Whitley St.,

Whittier, Calif. 90601

Filed Aug. 13, 1963, Ser. No. 301,770

4 Claims. (Cl. 222-43)

This invention relates generally to syringes and relates more particularly to syringes used in making chromatographic analyses.

While the invention has particular utility embodied in syringes used in chromatography, and is shown and described thus embodied, it is to be understood that its utility is not confined thereto.

Various problems and difficulties are encountered in making chromatographic analyses, and it is an object of the present invention to solve the problems involved and difficulties encountered in this work.

It is another object of the present invention to provide a syringe for analyses by chromatography that has the high speed and extreme accuracy of operation required in instruments for such use.

It is still another object of the invention to provide a device of this character that is easy to use.

It is a further object of the invention to provide a device of this character that has a constant discharge rate.

It is a still further object of the invention to provide a device of this character that may be operated with one hand.

Another object of the invention is to provide a device of this character which is adjustable over a very wide range, having, for example, a micrometer adjustment between 1 and 200 microliters.

Another object of the invention is to provide a device of this character that is usable from 10 microliters to 200 microliters with repeatable accuracy.

A further object of the invention is to provide a syringe of this character having means for extremely accurate and precise adjustments whereby different precise and uniform deliveries of liquid or fluid volumes may be quickly and easily made so as to make possible accurate and reproducible test results in analytical chromatography.

It is a still further object of the invention to provide a device of this character that is changeable from volume to volume and back again to an original volume with a resettable extreme accuracy, such as, for example, $\pm 0.3\%$.

It is another object of the invention to provide a syringe of this character having a micrometer-like adjustment means having a lock ring for maintaining settings, said ring being so mechanically positioned in rotation to the thread tolerances (back lash) in the micrometer screw thread, that on setting a new delivery volume, tension is put on the threads, pulling them to a precise point, thus assuring repeatable accuracy in returning to a given volume.

It is still another object of the invention to provide a device of this character having improved control means which includes a trigger or latch mechanism which permits a uniform discharge delivery or rate and repeatable delivery time.

It is a further object of the invention to provide a device of this character having an extremely short and uniform discharge time, thereby improving accuracy.

Samples analyzed by chromatography are usually relatively small and considerable skill has been required on the part of the operator in using a syringe repeatedly in this type of analysis. The present invention, however, provides a syringe with which the desired results can be

readily secured by operators with little or no prior practice or training.

The characteristics and advantages of the invention are further sufficiently referred to in connection with the following detailed description of the accompanying drawings, which represent one embodiment. After considering this example, skilled persons will understand that variations may be made without departing from the principles disclosed and I contemplate the use of any structures, arrangements, or modes of operation that are properly within the scope of the appended claims.

Referring to the drawings, which are for illustrative purposes only:

FIG. 1 is a side view of a syringe embodying the present invention;

FIG. 2 is an enlarged longitudinal section through same taken on line 2-2 of FIG. 1, showing the plunger in the cocked position;

FIG. 3 is a fragmentary longitudinal section of the rear end portion of the syringe, showing the device in the released position;

FIG. 4 is a sectional view taken on line 4-4 of FIG. 2;

FIG. 5 is a longitudinal sectional view of an alternative barrel and needle assembly.

Referring more particularly to the drawings, there is shown a syringe embodying the present invention and including a tubular barrel, indicated generally at 10. Tubular barrel 10 has a relatively thick walled rear portion 12, the rear end of which has a wall 14 having an axial opening 16 therethrough and a transverse bore 18 of greater diameter than the opening 16. Bore 18 extends from the exterior of the barrel into and beyond the opening 16, said bore 18 being closed at its inner end as by a wall portion 20.

At the rear or inner end portion the rear portion 12 is interiorly threaded at 22 and from the forward end of the threaded portion the interior of the rear portion 12 is enlarged as at 24, the interior surface of the enlarged portion 24 being smooth.

A forward end part of the barrel is of reduced external diameter, said forward end part being indicated generally at 26. At forward end of part 26 there is a thimble 28 which is tapered and terminates in an end wall 30 that is normal to the axis of the thimble. Intermediate the ends of end part 26 there is an externally threaded enlargement 32 behind which is an external annular flange 34 which tapers rearwardly and outwardly from the base of the rear end of the enlargement 32.

Reduced diameter portion 26 is provided with a plurality of longitudinally extending annularly spaced slots 36. These slots extend longitudinally from the forward end of the enlargement 32 to a point adjacent the rear end of the part 26, so that said slots extend through the enlargement 32 and flange 34 and into the interior of said end part 26. Thus there are provided resilient yielding segments or clamping elements 40 between the slots 36. Since the slots 36 extend through the flange 34 each of the clamping elements is provided with a portion of said flange and the forward ends of these portions of said flange provide wedges 42 which face forwardly.

Threadably disposed on the enlargement is an internally threaded locking ring 44 having its outer surface knurled. Rotation of the locking ring in one direction will cause same to move rearwardly on the externally threaded enlargement and rotation of said ring in the opposite direction will cause same to move forwardly. Upon rotation of the locking ring in a direction to cause same to move rearwardly the rear end of said ring will engage the wedges 42 of the respective clamping elements and continued rearward movement of the locking ring will

cause the clamping elements to be urged inwardly. Movement of the locking ring in the opposite direction will, of course, cause same to move away from the wedges 42 and permit the clamping elements 40 to return to their normal position. It is to be noted, however, that the movements of the clamping elements are small.

The thimble 28 of the end part 26 is provided with graduated markings which are, in turn, provided with numbers.

An inner sleeve 46 which is tubular and is rotatably disposed within the tubular barrel 10 and is also movable longitudinally therein. Intermediate its ends the inner sleeve 46 is provided with a reduced diameter part 48 and rearwardly thereof said inner sleeve is externally threaded as at 50 for threadable engagement with the internally threaded portion 22 of the barrel. Reduced diameter portion 48 provides a relieved portion of the inner sleeve to permit longitudinal movements of said sleeve as same is rotated within the barrel. Adjacent its forward end the exterior of the inner sleeve is provided with a graduated scale 52 which extends longitudinally thereof and has cooperative relationship with the graduated end portion or thimble 28, having the markings thereof annularly spaced apart thereon. Thus a micrometer type of adjustment is provided. The barrel and inner sleeve may be considered a barrel assembly.

Adjacent the forward end of the inner sleeve is an internal annular flange 54 which defines an axial opening 56. At its forward end the inner sleeve 46 has an enlarged end portion 58 which is internally threaded for threadable reception of an externally threaded rear end portion 60 of a cap, indicated generally at 62. An annular gasket 64 is disposed between the flange 54 of the inner sleeve and the rear end of the cap 62, the axial opening 66 of the gasket 64 being of a size larger than plunger head 104.

Operably disposed within the tubular cap is a transparent cylinder 70 which is shown as being of glass although it could be made of other suitable material. Cylinder 70 extends axially relative to the barrel 10 and inner sleeve 46 and is provided with an axial passage or bore 72 therethrough.

The rear end of the transparent cylinder 70 sealingly abuts against the gasket 64, said gasket providing a cushion to protect the cylinder against breakage. At its forward end there is a needle gasket, indicated generally at 74, which is of plastic or other suitable material. One plastic material that provides a suitable gasket is of the fluorocarbon resin family, for example, Teflon, which is DuPont's registered trade-mark for its family of fluorocarbon resins, include TFE (tetrafluoroethylene) resins and FEP (fluorinated ethylene propylene) resins.

Needle gasket 74 includes a cylindrical part 76 which is sealingly positioned in a forward end portion of the bore 72 of the cylinder 70 and at its forward end said needle gasket is provided with an annular flange 78 which is of substantially the same diameter as the interior of the cap 62. When cap is operably secured to the forward end portion 58 of the inner sleeve the forward end of the transparent cylinder 70 sealingly engages the flange 78 of the needle gasket but is spaced from the adjacent end wall 80 of the cap and the opposite side of said flange 78 engages an end wall 80 of the cap.

Needle gasket 74 has an axial bore 82 therethrough which terminates at the forward end of said gasket in a flaring recess 84. End wall 80 has an interior recess which includes a cylindrical portion 86 at the inner side or end portion of said wall 80 and said recess is tapered inwardly and forwardly at 88. A resilient ball 90 of rubber, or any other suitable resilient material, is disposed in the cavity provided by the opposed recesses respectively in the needle gasket and in the wall 80. A needle 92 is disposed within the bore 82 of the needle gasket and extends through the ball 90 and through a bore 94 which extends axially through the wall 80 outwardly of the inwardly and forwardly tapered portion 88 of the wall re-

cess. Since the end wall 80 is spaced from the flange 78 of the needle gasket 74 said end wall exerts a compressive force on the resilient ball 90 so that said ball provides a seal for the needle when the cap and the parts therein are assembled and operably attached to the inner sleeve 46.

It is to be noted that the inner end of the needle 92 does not extend entirely through the cylindrical part 76 of the needle gasket 74. This gasket 74 and the cylinder 70 may be considered a cylinder means and these parts may be cemented together with an epoxy cement or the like.

In some types of syringes, such as are used in dental work, for example, the ball 90 may be of metal and formed on the needle.

Within the barrel 10 and sleeve 46 there is operably disposed a plunger rod 100 having an external diameter substantially less than the internal diameter of the inner sleeve 46. Plunger rod 100 is provided at its forward end with a reduced diameter extension 102 having an enlargement or head 104, said enlargement having a rounded outer or forward end. The extension 102 carries, at its forward end, a plunger, indicated generally at 106, which comprises a cylindrical body 108 of smaller external diameter than the diameter of the bore 72 of the glass cylinder 70 in which said plunger is adapted to reciprocate. At the forward end of the plunger has a piston portion 112 which is snugly received in said bore 72 to effect movement of fluid in said bore, as will be described more particularly hereinafter. It is to be noted that the plunger is of a suitable material, which may be a plastic, it having been found that Teflon provides a very satisfactory plunger.

Body 108 of the plunger has an axial section 114 which extends forwardly from the rear end thereof and is provided at the inner end with an enlarged part for operable reception of the head 104 of the plunger extension 102. By having the forward end of the head 104 rounded, said head may be readily forced through the bore 114 to the inner end thereof. The rear end of head 104 is provided with a shoulder 116 which is in a plane normal to the axis of the plunger and engages a corresponding shoulder in the plunger bore 114 so that the plunger will be moved to the right with corresponding rightward movement of the plunger rod. The plunger will also be forced forwardly with leftward movement of the plunger rod by reason of the engagement of the forward end of head 104 with the inner end of the bore 114. While plunger 106 is moved longitudinally within the bore 72 with corresponding movements of the plunger rod, said plunger freely rotates on the end of the extension 102.

A rear end portion 120 of the plunger rod is externally threaded and a sear nut, indicated generally at 122, is disposed on said rod and threadably secured thereon, said sear nut having a rear end portion internally threaded for threading onto the threaded portion 120 of said plunger rod. Sear nut 122 has a reduced diameter portion or annular groove 124 adjacent the forward end thereof leaving a collar 126 at the forward end of the sear nut. The wall defining the rear end of said groove 124 provides a shoulder 128 substantially normal to the axis of the plunger rod and sear nut.

The sear nut is slidably disposed in the axial opening 16 of the rear portion 14 of the barrel and is also disposed in a transverse bore 130 of a cylindrical latch 132 which is slidably disposed in the cross bore 18 in the end wall 14 of the barrel 10. The first bore 130 in the latch 132 is of slightly greater diameter than the external diameter of the sear nut, there being an enlarged diameter bore portion or counterbore 134 at the rear of the latch, said counterbore being coaxial with the transverse bore 130. At the junction of the counterbore with the transverse bore 130 there is a sharp shoulder 136 normal to the axis of the bore and counterbore. At the rear end of the sear nut there are opposed flattened faces or sur-

faces 138 whereby said nut may be engaged with a suitable tool for tightening same on the threaded portion 120 of the plunger rod or loosening same. A button 140, having an axial tapped bore 142 is screwed onto the rear end of the threaded portion 120 of the plunger rod. Adjacent the forward end of the plunger rod and behind the extension 102 is a retainer ring 144 removably disposed in a groove provided therefor at the forward end of said plunger rod. Within the space or annulus 146 between the plunger rod and the inner wall of the inner sleeve 46 and the interior of the barrel 10 is a spring 148 having one end reacting against the retainer ring 144 and the opposite end reacting against the forward end of the wall 14 of the tubular barrel 10 to thereby yieldably urge the plunger rod forwardly.

Latch 132 is urged upwardly, as shown in FIG. 2, or outwardly relative to the bore 18, by a spring 150, one end of said spring being disposed in a spring retaining recess 152 of the wall 20 closing the inner end of the bore 18. The opposite end of said spring is received in a spring retaining recess 154 in the inner end of the latch 132. Thus the latch 132 is urged in a direction to cause the lower part of the bore 130 to engage the adjacent portion of the sear nut rearwardly of the groove 124. When the plunger rod is pulled outwardly by means of the button 140 the shoulder 136 of the latch 132 will engage the shoulder 128 of the sear nut, as best shown in FIG. 2. When the plunger rod is pulled rearwardly and with the free end of the needle disposed in fluid to be used, said fluid is drawn through the needle and into that portion of the bore 72 of the cylinder 70 ahead of the piston 112 so that the syringe is thereby charged with fluid. Radially inward pressure on the latch 132 will effect release of the plunger rod and permit spring 148 to suddenly move said plunger rod forwardly with substantial force, thereby driving the fluid in the bore 72 ahead of the piston 112 outwardly through the needle 92.

It is to be understood that a resilient ball, such as a rubber ball, may be used instead of the spring 150.

In order to vary the volume of fluid to be discharged by the syringe the locking ring 44 is screwed forwardly to release the inner sleeve 46 so that there can be relative rotation between the barrel 10 and said inner sleeve 46. Such relative rotation will cause the inner sleeve and barrel to move longitudinally relative to each other and the amount of such movement is shown on the scale 52 on the inner sleeve and the graduated scale marking on the forward end portion 28 of the thimble. When the proper adjustment has been made the locking ring 44 is screwed rearwardly to effect locking of the barrel and inner sleeve together. Thereafter very exact and precise amounts of fluid may be drawn into the forward portion of the bore 72 of cylinder 70 and discharged. The device provides very precise and uniform deliveries of fluid volumes and all of the various objects of the invention are effected with the above described mechanism.

If desired the cap 62 may be provided with a plurality of longitudinally extending annularly spaced slots 160 to permit viewing therethrough of the transparent cylinder 70 and the plunger.

In FIG. 5 there is shown an alternative barrel and needle arrangement, wherein the tubular needle 166 has one end disposed in the bore 168 extending longitudinally through a hub 170. The needle is secured in the hub by a suitable cement such as, for example, an epoxy cement, there being such cements presently available on the market. The hub 170 is of such size as to be slidably received in the forward end of the bore 72 of the cylinder 70 and is cemented therein by any suitable cement such as the epoxy cement described above.

An annular gasket 172 of suitable material such as, for example, Teflon, is disposed about the needle 166 and between the adjacent end of the cylinder 70 and the forward end wall 80 of the cap 62 to thereby secure the barrel in operative position in the cap.

The invention and its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of the parts of the invention without departing from the spirit and scope thereof or sacrificing its material advantages, the arrangements hereinbefore described being merely by way of example, and I do not wish to be restricted to the specific forms shown or uses mentioned except as defined in the accompanying claims, wherein various portions have been separated for clarity of reading and not for emphasis.

I claim:

1. A syringe, comprising:

(A) a tubular barrel assembly including

(1) a tubular barrel having

(a) a wall at one end with an axial bore therethrough, said barrel being open at the opposite end which terminates in

(b) a thimble with a frusto-conical free end portion having annularly spaced scale markings thereon, there being an internally threaded portion adjacent said wall,

(c) an externally threaded annular enlargement adjacent said free end, there being a plurality of longitudinally extending, annularly spaced slots through the enlargement and a portion of the barrel rearwardly of said enlargement to thereby provide a plurality of resilient clamping elements;

(d) a clamping wedge for each clamping element, said clamping wedges having their outer surfaces extending outwardly and rearwardly from a location adjacent the enlargement;

(e) an internally threaded locking ring threadably disposed on said enlargement and adapted to be screwed toward said wedges to thereby engage the inclined surfaces thereof and force same inwardly and thereby correspondingly move said clamping elements, said locking ring being adapted to be screwed forwardly to a wedge disengaged position;

(2) an inner sleeve having its inner end provided with an externally threaded portion engageable with the interior threads of the barrel, said sleeve projecting forwardly of the forward end of said barrel and being rotatable in said barrel to effect relative longitudinal movement of said sleeve and barrel, said inner sleeve having a graduated scale with longitudinally spaced marks thereon cooperable with the scale on the thimble to thereby provide a micrometer arrangement for calibrating the syringe and determining the volume of fluid discharged therefrom;

(B) a hollow cylinder connected to the forward end of said inner sleeve;

(C) a plunger rod operably disposed in the bore of said barrel wall, said barrel, inner sleeve, and cylinder;

(D) a plunger operably disposed within said cylinder, said plunger being mounted on the adjacent end of said plunger rod;

(E) yielding means for resiliently urging the rod in a direction to effect discharge of fluid from said cylinder;

(F) and a latch for releasably holding the plunger rod to maintain the plunger temporarily in a retracted position.

2. A syringe, comprising:

(A) a tubular barrel assembly including

(1) a tubular barrel having internal threads,

(a) open at one end, said one end having annularly spaced scale markings thereon,

(b) an externally threaded annular enlarge-

ment adjacent said free end, there being a plurality of longitudinally extending, annularly spaced slots through the enlargement and a portion of the barrel member rearwardly of said enlargement to thereby provide a plurality of resilient clamping elements,

(c) clamping wedge means for said clamping elements, said clamping wedge means adjacent the enlargement,

(d) an internally threaded locking ring threadably disposed on said enlargement and adapted to be screwed toward said wedge means to thereby engage same and force the clamping elements inwardly, said locking ring being adapted to be screwed to a wedge disengaged position;

(2) an inner sleeve having its inner end provided with an externally threaded portion engageable with the internal threads of the barrel, said sleeve projecting forwardly of the forward end of said barrel and being rotatable relative to said barrel to effect relative longitudinal movement of said sleeve and barrel, said inner sleeve having a graduated scale with longitudinally spaced marks thereon cooperable with the scale on said one end of the barrel to thereby provide a micrometer arrangement for adjusting the syringe and determining the volume of fluid discharged therefrom;

(B) a hollow cylinder connected to the forward end of said inner sleeve;

(C) a plunger rod operably disposed in said barrel, inner sleeve and cylinder;

(D) a plunger operably disposed within said cylinder, said plunger being operably mounted on the adjacent end of said plunger rod;

(E) yielding means for urging said rod in a direction to effect discharge of fluid from said cylinder;

(F) and a latch for releasably holding the plunger rod to maintain the plunger in a retracted position.

3. In capacity adjusting means for a syringe:

(A) a tubular barrel assembly including

(1) a tubular barrel

(a) a wall at one end with an axial bore therethrough, said barrel being open at the opposite end which terminates in

(b) a thimble with a frusto-conical free end portion having annularly spaced scale markings thereon, there being an internally threaded portion adjacent said wall,

(c) an externally threaded annular enlargement adjacent said free end, there being a plurality of longitudinally extending, annularly spaced slots through the enlargement and a portion of the barrel rearwardly of said enlargement to thereby provide a plurality of resilient clamping elements;

(d) a clamping wedge for each clamping element, said clamping wedges having their outer surfaces extending outwardly and rearwardly from a location adjacent the enlargement;

(e) an internally threaded locking ring threadably disposed on said enlargement and adapted to be screwed toward said wedges to thereby engage the inclined surfaces thereof and force same inwardly, said locking ring being adapted to be screwed forwardly to a wedge disengaged position;

(2) an inner sleeve having its inner end provided with an externally threaded portion engageable with the interior threads of the barrel, said sleeve projecting forwardly of the forward end of said barrel and being rotatable in said barrel to effect relative longitudinal movement of said sleeve and barrel, said inner sleeve having a graduated scale with longitudinally spaced marks thereon cooperable with the scale on the thimble to thereby provide a micrometer arrangement for calibrating the syringe and determining the volume of fluid discharged therefrom.

4. In capacity adjusting means for a syringe:

(A) a tubular barrel,

(1) said barrel having an open free end with an annularly arranged scale adjacent said free end;

(2) said barrel having a plurality of annularly spaced longitudinally extending slots therein providing therebetween resilient clamping elements integral with the barrel at their ends;

(3) an externally threaded portion adjacent said clamping elements;

(4) pressure elements on said clamping elements;

(B) an internally threaded part rotatably disposed on said externally threaded portion of said barrel and movable longitudinally thereon into and out of engagement with said pressure elements for moving said clamping elements radially inwardly and permitting same to move radially outwardly;

(C) and an internal sleeve in said barrel having threaded connection therewith whereby rotation of said barrel and sleeve relative to each other will effect relative longitudinal movement thereof, said sleeve having a longitudinally extending external scale thereon cooperable with the scale on said barrel.

References Cited

UNITED STATES PATENTS

1,641,976	9/1927	Laurent	128—220
2,129,675	9/1936	Cole	128—218
2,169,371	9/1939	Payne	128—221
2,380,534	7/1945	Lockhart	128—218
2,409,656	10/1946	Austin	128—218
2,562,129	7/1951	Scherer et al.	128—221
2,643,655	6/1953	McKay	128—220
2,645,097	7/1953	Posch	128—2 X
3,096,763	7/1963	McConnaughey et al.	128—221

FOREIGN PATENTS

369,122	10/1966	France.
496,696	12/1936	Great Britain.

RICHARD A. GAUDET, *Primary Examiner*.

SIMON BRODER, *Examiner*.