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C. H. HAMILTON

3,101,084

SYRINGE

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Fig. 1.

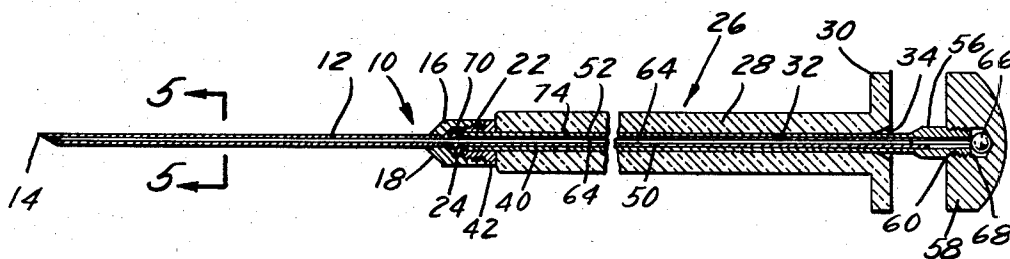


Fig. 2.

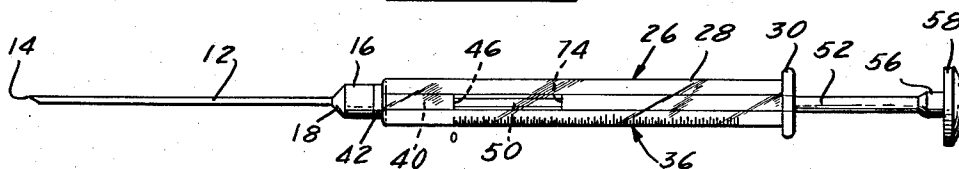


Fig. 3.

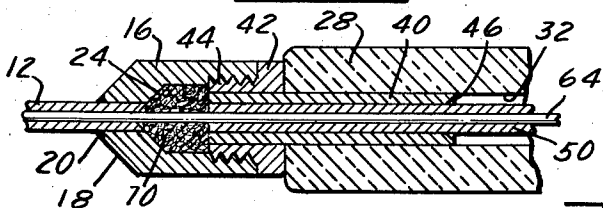


Fig. 5.

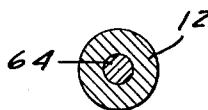


Fig.

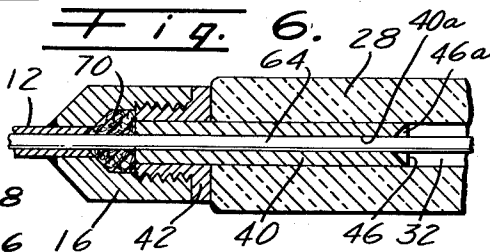
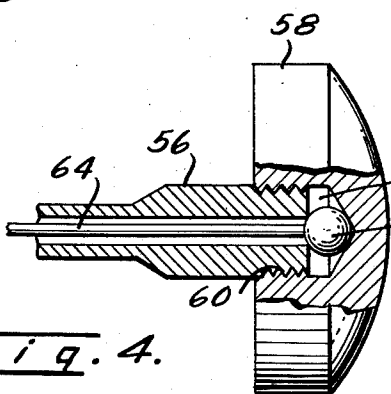


Fig. 4.



Clark H. Hamilton
INVENTOR.

BY *Jo Baisch*

Attorney

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3,101,084
SYRINGE

Clark H. Hamilton, 707 Whitley, Whittier, Calif.
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This invention relates generally to syringes and relates more particularly to syringes having a very small volumetric capacity.

While the invention has particular utility embodied in syringes of extremely small volumetric capacity, and is shown and described embodied therein, it is to be understood that its utility is not confined thereto.

Various problems and difficulties have been encountered in providing syringes of extremely small volumetric capacity and it is an object of the present invention to provide such a small capacity syringe which will solve said problems and overcome said difficulties.

It is another object of the invention to provide a syringe of this character which has a zero loss of medicant or chemical sample.

It is still another object of the invention to provide a device of this character which will effectively handle extremely small amounts of fluid (gas or liquid), such as medicants, chemicals, or the like.

It is a further object of the invention to provide a device of this character wherein the needle acts with both as a syringe fluid reservoir and an injection element.

It is a still further object of the invention to provide a device of this character wherein a hard needle tubing is precisely fitted with a plunger or plunger surface of a hard metal dissimilar from the needle or interior surface of the needle contacted by the plunger surface.

It is another object of the invention to provide a device of this character wherein the plunger displacement is read directly on a graduated scale.

It is still another object of the invention to provide a device of this character wherein there is a plunger guide assembly which supports the very small diameter plunger and permits free precise movements thereof.

It is a further object of the invention to provide a seal effective for leakage of fluid, gas or liquid resulting from wear or corrosion.

It is a still further object of the invention to provide a device of this character which prevents wiping in of dirt by the plunger from the outside, such as would make the syringe inoperable.

It is another object of the invention to provide a device of this character wherein capillary movement of liquid up the plunger and needle surfaces, such as would destroy the precision of delivery volume, is prevented.

A further object of the invention is to provide a device of this character wherein air seepage is prevented.

It is a still further object of the invention to provide a device of this character that is extremely accurate.

It is another object of the invention to provide a device of this character that is extremely reliable.

It is still another object of the invention to provide a device of this character that is relatively simple in construction.

A further object of the invention is to provide a device of this character that may be readily and easily assembled, or disassembled, for servicing or replacement of parts.

It is a still further object of the invention to provide

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a device of this character that is relatively inexpensive to manufacture.

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 many variations may be made without departing from the principles disclosed and I contemplate the employment 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 longitudinal section through a syringe embodying the present invention;

FIG. 2 is a side view of the device;

FIG. 3 is an enlarged longitudinal sectional view of a portion of said syringe;

FIG. 4 is an enlarged side view, partially in section, of the outer end of the plunger assembly;

FIG. 5 is a sectional view taken on line 5—5 of FIG. 1; and

FIG. 6 is an enlarged longitudinal sectional view of an alternative arrangement.

Referring more particularly to the drawings, there is shown a syringe having a needle assembly, indicated generally at 10, including a hollow or tubular needle 12 provided with a sharp point 14 at the outer or free end thereof, said needle serving both as a syringe reservoir and as an injection device. Needle 12 may be of any suitable material, such as a hard metal, platinum alloy or stainless steel being examples of suitable materials for such needles.

At the end of the needle opposite the point 14 said needle is provided with a female needle hub 16 having a wall 18 at its outer end provided with an axial opening therein for reception of the adjacent end portion of the needle 12, said needle being welded or staked, as indicated at 20, to said hub. Hub 16 has a recess extending inwardly from the opposite end which is open. Extending from the open end, a portion of said hub is internally threaded as at 22, there being a gasket chamber 24 at the inner end of the recess in the hub 16.

The needle assembly 10 is connected to a volume indicating device or assembly, indicated generally at 26, said assembly comprising a transparent body 28 of any suitable material, such as glass, for example. At the outer end the body 28 is provided with an outwardly extending annular flange 30 and there is an axial bore 32 through said body, said bore flaring outwardly at the flanged end of the body, said flare portion of the bore being indicated at 34.

On the exterior of the body there is a scale, indicated generally at 36, which is put on said body by any suitable well known means, such as silver screening.

At the end of the body 28 opposite the flange 30 thereof a zero stop and needle screw sleeve 40 is disposed in the outer end portion of the bore 32, said zero stop and needle screw sleeve being cemented in said bore by any suitable well known cement, such as epoxy cement, for example. A portion of the outer end of sleeve 40 extends outwardly beyond the adjacent end of the body 28 and has disposed thereon a male needle screw 42 having a reduced diameter externally threaded outer end portion

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44 on which the female threaded needle hub 16 is screwed. The male needle screw 42 is secured to the zero stop sleeve 40 by any suitable means, such as, for example, welding, cementing or staking. It is to be noted that the inner end 46 of the zero stop sleeve 40 is in exact register with the adjacent end of the scale 36 which is the zero point or mark of said scale.

The interior diameter of the zero stop sleeve 40 is sufficiently large to receive therein a forward end portion of a tubular inner plunger guide 50, said forward end portion of the guide 50 being secured in the zero stop sleeve by any suitable means, such as cementing, or the like. Inner plunger guide is arranged axially in the bore 32 in body 28 and extends rearwardly from the stop sleeve 40. As shown in FIG. 1 the inner plunger guide extends outwardly or rearwardly of the flanged end of the body 28 although it need not extend this far rearwardly. It is to be noted that the forward end of the zero stop sleeve and the forward end of the inner plunger guide terminate in the same plane as the forward end of the reduced diameter externally threaded part 44 of the male needle screw 42.

It is also to be noted that the zero stop sleeve is relatively short and extends but a short distance into the forward end portion of the body 28, thus leaving a major portion of the bore 32 outwardly of the outer end 46 of the zero stop sleeve free for slidable reception of a tubular volume indicating plunger guide 52, said volume indicating plunger guide 52 being slidable on the inner plunger guide 50.

At its outer ends the volume indicating plunger guide has a button and plunger retaining groove 56 which is shown as being integral with said volume indicating plunger guide 52 although said button and plunger retaining screw may be a separate part secured to the plunger guide 52 by cementing, welding or other suitable means.

The button and plunger retaining screw is provided with an axial bore of the same size as the bore or passage through the plunger guide 52 and forms a continuation thereof. A free end portion of the button and plunger retaining screw is externally threaded for threadable reception of a thumb button 58 which has an axial tapped bore 60 in the forward end thereof, the rear end of said button being convex and said bore is closed at the convex or back side.

Inner plunger guide 50 has an internal bore or passage extending axially therethrough of substantially the same size as the internal diameter of the needle 12 and a plunger 64 is slidably disposed within the inner plunger guide and the bore or passage through the needle 12.

It is to be noted that the plunger is of a dissimilar material or metal from that of the needle and said plunger may be, for example, of tungsten or a chrome plated wire. Plunger 64 is precisely fitted within the bore or passage of the needle but is slidable therein.

The back or rear end of the plunger is secured to a plunger retaining button 66 by welding or other suitable means; said button being disposed in a recess 68 at the inner end of the tapped bore 60 of the thumb button and when said thumb button is screwed onto the button and plunger retaining screw of the volume indicating plunger guide, the plunger and plunger guide 52 are secured together by the thumb button for operation together.

The plunger extends through the chamber 24 of the hub 16 and there is gasket material 70 in said chamber. The gasket material is of such character that it will flow under pressure which is created by the screwing of the hub 16 onto the part 44 of the needle screw 42. One suitable gasket material comprises fluorocarbon resins, such as "Teflon" (which is the registered trademark of E. I. du Pont de Nemours, Inc.) for such resins. The flowing under compression of the gasket material provides a gas and liquid-tight seal for the plunger portion

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passing through the seal 70 while permitting operative movements of said plunger.

The needle 12 not only functions as a needle but also functions as a volumetric syringe barrel reservoir, the volume of fluid in said needle being precisely displaced by the fitted plunger 64.

When the plunger assembly is moved into its fully telescoped position the inner or forward end of the volume indicating plunger guide engages the rear end of the zero stop sleeve at which time the forward end of the plunger bottoms at the needle point. Consequently there is no loss of fluid, gas or liquid handled by the syringe. In other words, there is a zero loss of such fluids.

The volume indicating plunger guide 52 and the inner plunger guide 50 support the plunger in alignment and allow free plunger movement with high precision. Further, by the precise fitting and telescoping plunger guides, or guide sleeves 50 and 52, respectively, the plunger displacement may be read on the graduated outboard scale 36. This plunger displacement is indicated by the forward end 74 of the volume indicating plunger guide as it registers with the various markings or lines of said scale 36.

The sealing gasket may be initially in the shape of a tubular part slidably receivable in the chamber 24 and slidably receiving the plunger. The gasket element must be somewhat longer than the chamber 24 and when the hub 16 is screwed onto the part 44 of the needle screw 42, the material of said gasket is crushed or compressed in said chamber to sealingly engage the interior of the needle hub 16 and the portion of the plunger disposed therein at any particular time.

The crushed sealing gasket acts in several ways. It seals for gross leakage of liquid or gas resulting from wear or corrosion. It prevents wiping in of dirt by the plunger from the outside which would make the syringe inoperative. Also, it prevents capillary movement of liquids up the plunger and needle surfaces which would destroy the precision of delivery volume and air seepage is prevented by the gasket assuring maximum accuracy.

In the above described arrangement the plunger is small and requires the support of the guide 50.

The alternative arrangement of FIG. 6 has a plunger of greater diameter and rigidity than that first described. In this FIG. 6 arrangement the zero stop sleeve 40 is secured in the body 28 as in the first described arrangement. The longitudinally extending bore 40a of the stop sleeve 40 is adapted to operably receive the plunger 64, the inner end of the zero stop sleeve 40 having an inwardly tapered recess 40a which provides a guide for the free end of the plunger when the device is being assembled. With this arrangement the free end of the plunger, when said plunger is inserted into the bore 32 of the body 28 from the rear thereof, will enter the recess 40a and be guided into the bore 40a of said zero stop sleeve 40. Upon further inward movement of the plunger said plunger will pass through the bore of the sleeve 40, through the seal 70, and into the bore of the needle 12, thus completing the assembly. Thereafter the hub 16 is tightened to compress the seal about the plunger. In operation the forward end of the volume indicating plunger guide 52 cooperates with the scale 36 to indicate the plunger displacement and said forward end bottoms on the inner end 46 of the zero stop sleeve 40.

In this arrangement the plunger and needle should also be of dissimilar metals, or at least their contacting surfaces should be of dissimilar metals. Very effective results have been obtained with tungsten to stainless steel contacting surfaces for respective parts or a platinum ruthenium alloy to stainless steel for the respective contacting surfaces.

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

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invention without departing from the spirit and scope thereof or sacrificing its material advantages, the embodiment hereinbefore described being merely for purposes of illustration.

I claim:

1. A syringe of very small volumetric capacity, comprising:

(A) a needle and volumetric barrel reservoir assembly comprising

(a) a needle of relatively hard metal, said needle having a sharp point at its free end and having a bore therethrough,

(b) and a female needle hub attached at one end to the end of the needle opposite the point, said hub having a bore extending inwardly from the free end, an outer end portion of said bore being threaded, the inner or forward end of said bore comprising a gasket chamber;

(B) a volume indicating device comprising,

(a) a transparent body having a bore therethrough, (aa) said body having a graduated scale thereon with a zero mark adjacent the forward end but spaced therefrom,

(bb) and an annular flange on the opposite end of said body,

(b) a tubular zero stop and needle screw sleeve secured within the forward end portion of the bore through said body with the inner end in register with the zero mark of the scale, the opposite end of said sleeve extending outwardly of the forward end of said body,

(c) a male needle screw secured to the forwardly extending portion of said zero stop and needle screw sleeve, said needle screw having an externally threaded forward end portion for threadable reception in the needle hub,

(d) an inner plunger guide having its forward end secured in said zero stop and needle screw sleeve and extending rearwardly in the bore of said body, said inner plunger guide having a bore therethrough and being of smaller external diameter than the internal diameter of the bore of the body;

(C) a plunger assembly including,

(a) a plunger of hard metal, different from the material of the needle, and having an external diameter precisely fitting within the bore through the needle,

(b) a tubular volume indicating plunger guide slidably disposed on the inner plunger guide and slidable in the bore of the body,

(c) a plunger retaining button secured to the rear end of said plunger, said plunger extending through the inner plunger guide and needle,

(d) an externally threaded, tubular plunger retaining screw secured to the rear end of the volume indicating plunger guide,

(e) a thumb button having a tapped recess in the forward end thereof threadably disposed on the plunger retaining screw, said plunger retaining button being disposed in said recess and held by the thumb button against the adjacent end of the plunger retaining screw to thereby secure together the parts of the plunger assembly,

(f) the parts of the plunger assembly being so proportioned and arranged that when said assembly is moved forwardly in the volume indicating device and needle the forward end of the plunger bottoms at the needle point when the forward end of the volume indicating plunger guide abuts against the rear end of the zero stop and needle screw sleeve, the thumb button and plunger retaining screw being spaced rearwardly of the flanged end of the body;

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(D) and crushed sealing gasket means in the gasket of the threaded needle hub.

2. A syringe of very small volumetric capacity, comprising:

(A) a needle and volumetric barrel reservoir assembly comprising

(a) a needle of relatively hard material, said needle having a bore therethrough and having a sharp point at its free end,

(b) and a needle hub attached at one end to the end of the needle opposite the point, said hub having a tapped bore extending inwardly from the free end;

(B) a volume indicating device comprising,

(a) a transparent body having a bore therethrough,

(aa) said body having a graduated scale thereon with a zero mark adjacent the forward end but spaced therefrom,

(bb) and an outwardly extending flange on the opposite end of said body,

(b) a tubular zero stop sleeve secured within the forward end portion of the bore through said body with the inner end in register with the zero mark of the scale, the opposite end of said sleeve extending outwardly of the forward end of said body,

(c) an externally threaded needle screw secured to the forwardly extending portion of said zero stop sleeve, said needle screw being threadably received in the needle hub,

(d) an inner plunger guide having its forward end secured in said zero stop sleeve and extending rearwardly in the bore of said body, said inner plunger guide having a bore therethrough and being of smaller external diameter than the internal diameter of the bore of the body;

(C) a plunger assembly including,

(a) a plunger of hard material different from the material of the needle and precisely fitting within the bore through the needle,

(b) a tubular volume indicating plunger guide slidably disposed on the inner plunger guide and slidable in the bore of the body,

(c) a plunger retaining button on the rear end of said plunger, said plunger extending through the inner plunger guide and the needle,

(d) an externally threaded plunger retaining screw on the rear end of the volume indicating plunger guide,

(e) and a thumb button having a tapped recess in the forward end thereof threadably disposed on the plunger retaining screw, said plunger retaining button being disposed in said recess and held by the thumb button against the adjacent end of the plunger retaining screw, thereby securing together the plunger and volume indicating plunger guide,

(f) the parts of the plunger assembly being so proportioned and arranged that when said assembly is moved forwardly in the volume indicating device and needle the forward end of the plunger bottoms at the needle point when the forward end of the volume indicating plunger guide abuts against the rear end of the zero stop sleeve, the thumb button and button and plunger retaining screw being spaced rearwardly of the flanged end of the body.

3. In a syringe of very small volumetric capacity:

(A) a needle and volumetric barrel reservoir assembly comprising

(a) a tubular needle of relatively hard material having a sharp point at its free end,

(b) and a needle hub attached on the end of the needle opposite the point, said hub having a

- tapped bore extending inwardly from the rear end;
- (B) a volume indicating device comprising,
- (a) a transparent body having a bore there-through, 5
- (aa) said body having a graduated scale thereon with a zero mark adjacent the forward end,
- (bb) and an outwardly extending flange on the opposite end of said body, 10
- (b) a tubular zero stop sleeve secured within the forward end portion of the bore through said body with the inner end in register with the zero mark of the scale, the opposite end of said sleeve extending outwardly of the forward end of said body, 15
- (c) a tubular, externally threaded needle screw secured to the forwardly extending portion of said zero stop screw sleeve, threadably receiving the needle hub thereon, 20
- (d) an inner plunger guide having its forward end secured in said zero stop sleeve and extending rearwardly in the bore of said body, said inner plunger guide having a bore therethrough and being of smaller external diameter than the internal diameter of the bore of the body; 25
- (C) a plunger assembly including,
- (a) a plunger of hard material, different from the material of the needle, said plunger being precisely fitted within the needle, 30
- (b) a tubular volume indicating plunger guide slidably disposed on the inner plunger guide and slidable in the bore of the body,
- (c) means for securing together the rear ends of said plunger and volume indicating plunger guide, said means including a thumb button, 35
- (d) the parts of the plunger assembly being so proportioned and arranged that when the plunger is moved forwardly in the volume indicating device and needle the forward end of the plunger bottoms at the needle point when the forward end of the volume indicating plunger guide abuts against the rear end of the zero stop sleeve. 40
4. In a syringe: 45
- (A) a needle and volumetric barrel reservoir assembly, comprising:
- (a) a tubular needle having a sharp point at its free end,
- (b) and a tapped hub at the end of the needle opposite the point, 50
- (B) a volume indicating device comprising,
- (a) a transparent tubular body having
- (aa) a graduated scale thereon with a zero mark adjacent the forward end, 55
- (b) a zero stop sleeve secured within the forward end portion of the bore through said body with the inner end in register with the zero mark of the scale, the opposite end of said sleeve extending outwardly of the forward end of said body, 60
- (c) a tubular, externally threaded needle screw secured to the forwardly extending portion of said zero stop and needle screw sleeve, 65
- (d) an inner plunger guide in said body with its forward end secured in said zero stop sleeve, said inner plunger guide having a bore therethrough and being of smaller external diameter than the interior of the body; 70
- (C) a plunger assembly including,
- (a) a plunger precisely fitting within the needle,
- (b) a tubular volume indicating plunger guide slidably disposed on the inner plunger guide,
- (c) and means operably securing together the

- volume indicating plunger guide and said plunger,
- (d) the parts of the plunger assembly being so proportioned and arranged that when the plunger is moved forwardly in the volume indicating device and needle the forward end of the plunger bottoms at the needle point when the forward end of the volume indicating plunger guide abuts against the rear end of the zero stop sleeve.
5. In a measuring and discharge syringe of very small volumetric capacity:
- (A) a needle and volumetric barrel reservoir assembly comprising:
- (a) a tubular needle having a sharp point at its free end;
- (B) a plunger precisely fitted in said needle and slidable therein;
- (C) guide and support means for said plunger and said needle;
- (D) and volume indicating means incorporated in the syringe for indicating the volume displacement in said needle by said plunger.
6. In a syringe:
- (A) a tubular needle;
- (B) a plunger operably fitted and slidable in said needle;
- (C) support means for said plunger;
- (D) interconnecting means connecting said support means and needle and having a chamber therein for gasket and material, said plunger extending through said chamber;
- (E) and crushable gasket material in said chamber and in engagement with the portion of said plunger in said chamber, said interconnecting means having parts movable relative to each other to compress said gasket material on said plunger to provide a seal for said plunger.
7. In a syringe:
- (A) a needle and volumetric barrel reservoir assembly, comprising:
- (a) a tubular needle having a sharp point at its free end;
- (B) a volume indicating device comprising:
- (a) a transparent body having a longitudinal bore therethrough,
- (aa) a graduated scale thereon with a zero mark adjacent the forward end,
- (b) a zero stop sleeve secured within the forward end portion of the bore through said body with the inner end in register with the zero mark of the scale, the opposite end of said sleeve extending outwardly of the forward end of said body, said sleeve having an inwardly tapering recess in the inner end from which a longitudinal bore extends to the outer end, the end of said needle opposite the sharp pointed end being secured to said stop sleeve;
- (C) a plunger assembly including
- (a) a tubular volume indicating plunger guide slidably disposed in the bore of said body,
- (b) a plunger precisely fitting within the needle, and having a rearward portion disposed in said plunger guide,
- (c) and means operably securing together the volume indicating plunger guide and said plunger,
- (d) the parts of the plunger assembly being so proportioned and arranged that when the plunger is moved forwardly in the volume indicating device and needle the forward end of the plunger bottoms at the needle point when the forward end of the volume indicating

plunger guide abuts against the rear end of the
zero stop sleeve.

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