

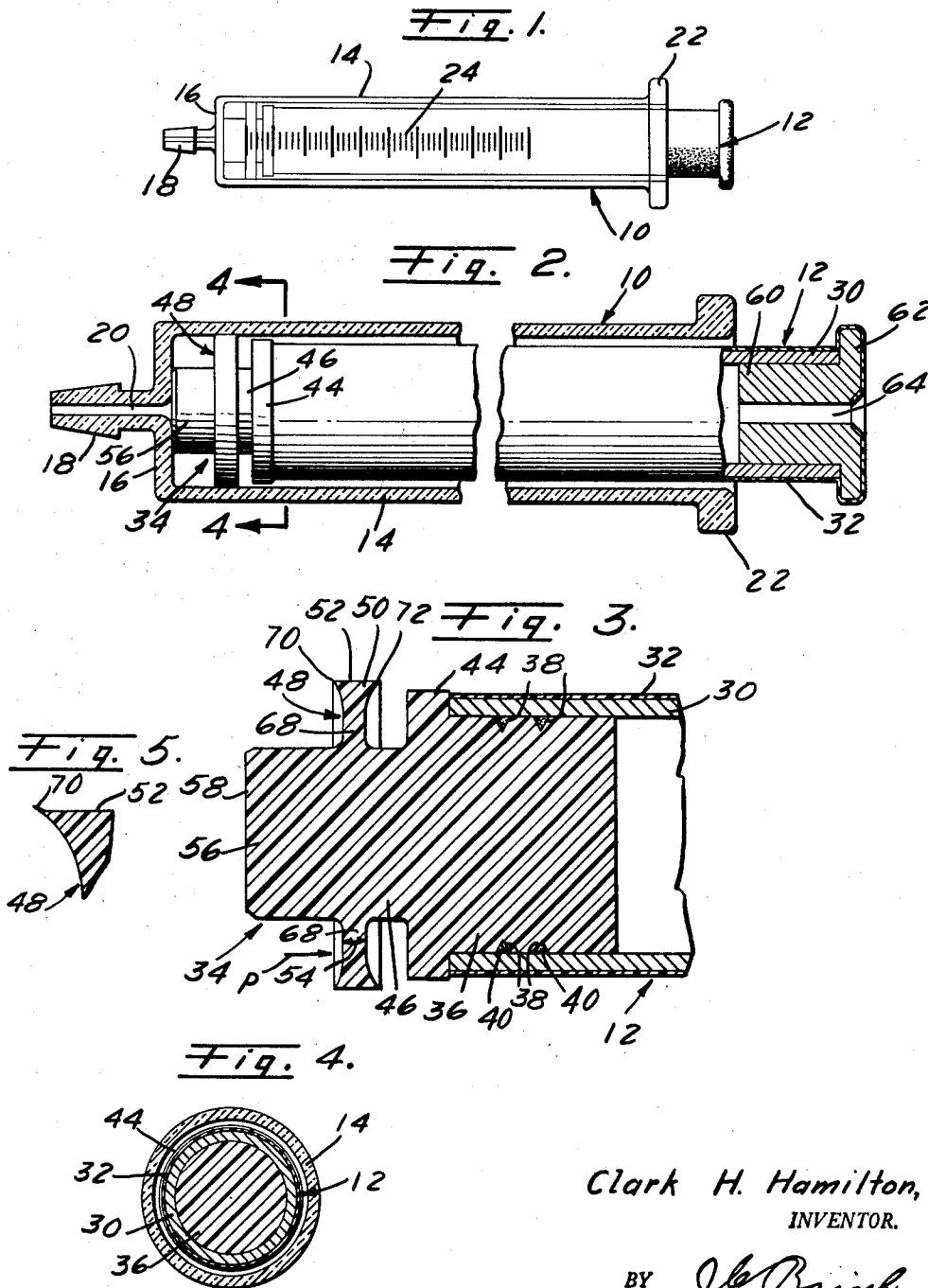
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C. H. HAMILTON

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SYRINGE

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Clark H. Hamilton,
INVENTOR.

BY *John Barish*
Attorney

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SYRINGE

Clark H. Hamilton, 1134 Whitley, Whittier, Calif.
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This invention relates generally to syringes and relates more particularly to gas-tight syringes for laboratory use and the like.

While the invention has particular utility embodied in syringes for handling gases, corrosion liquids, and the like, 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 for pipetting gas and/or corrosion liquids, and it is an object of the present invention to solve these problems and overcome said difficulties.

Another object of the invention is to provide a syringe of this character that is substantially gas-tight and has a minimum leak rate.

Still another object of the invention is to provide a syringe of this character that is highly satisfactory for gas chromatography, and for pipetting gas.

Certain corrosion liquids will cement syringe plungers to the barrel and it is a further object of the present invention to provide a syringe which may be used for pipetting such corrosion liquids without such cementing of the plunger to the barrel.

A still further object of the invention is to provide a syringe of this character having an extremely high degree of accuracy.

Another object of the invention is to provide a syringe or device of this character wherein the plunger is highly effective when operated in either direction within the barrel.

Still another object of the invention is to provide a syringe of this character wherein contamination of gas by residual gas is eliminated.

A further object of the invention is to provide a syringe of this character wherein tilting of the plunger is eliminated.

A still further object of the invention is to provide a syringe of this character that is free from binding spots, giving a smooth and uniform delivery.

Another object of the invention is to provide a syringe of this character that has a smoothly moving plunger.

Still another object of the invention is to provide a syringe of this character that has a stiff plunger which makes the device spill free.

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 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 side view of a syringe embodying the present invention;

FIG. 2 is an enlarged longitudinal section of the device showing the plunger in side elevation but with a portion thereof broken away;

FIG. 3 is an enlarged longitudinal section of the forward end of the plunger;

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

FIG. 5 is an enlarged fragmentary section of a portion of the sealing flange.

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Referring more particularly to FIGS. 1 and 2 of the drawings, there is shown a syringe having a barrel, indicated generally at 10, with a plunger, indicated generally at 12, operably disposed therein.

The barrel 10 is of any suitable material such as transparent glass for example, and includes a hollow cylindrical body or body portion 14 with a wall 16 closing one end and from which a tip or nipple 18 extends axially outwardly adapted for attachment of a hypodermic needle or the like, not shown, there being a fluid passage 20 extending from the interior of the barrel body and through the nipple. The end of the barrel body opposite the wall 16 is fully open and is provided with an outwardly extending flange 22 which serves as a handle for engagement by the fingers of the operator of the device when forcing the plunger 12 inwardly. If desired, the flange may be oval in shape with oppositely arranged generally parallel sides which prevent the device from rolling when placed on a flat surface.

A scale 24 is provided on the exterior of the barrel body portion 14, said scale being very accurately calibrated, having an accuracy of 1% or better.

The plunger 12 comprises a tubular member 30 of suitable length and material. Stainless steel has been found to be particularly suitable for this part of the plunger although it may be of other material. The exterior of the plunger member 30 is provided with a thin coating 32 of "Teflon" which may be sprayed on or otherwise applied, the outside diameter of the member 30 and its coating 32 is somewhat smaller than the inside diameter of the body 14 of the barrel. The "Teflon" coating 32 is corrosion resistant and provides an exterior surface that slides smoothly and substantially without friction within the body 14 of the barrel 10.

At one end of the member 30 there is a plunger head indicated generally at 34, of suitable plastic material. Du Pont's "Teflon" which is the registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins, having been found to meet the strict requirements of scientific laboratories, the TFE resins having been found to be very satisfactory.

Head 34 includes an anchoring and support part 36 secured within the adjacent end of the member 30. In order to provide a suitably secure attachment, the outside diameter of the support part 36 is the same as the inside diameter of the member 30 plus approximately .001" so as to provide a firm press fit of the support part 36 within said member 30.

The part 36 is further secured within the member 30 by a suitable adhesive such as, for example, epoxy cement which is applied to the exterior of the support part 36 prior to its being pressed into the member 30.

The interior surface of the member 30 engaged by the part 36 may be roughened somewhat by any suitable known means to insure maximum adhesion of the cement thereto. Also the support part 36 is externally grooved for reception of adhesive therein, there being a plurality of grooves, indicated at 38, which are spaced apart longitudinally of the support part 36. The cement is indicated at 40. To provide maximum adhesion of the cement to the exterior surface of the support part 36, said surface is roughened by any suitable means.

At the outer end of the anchoring and/or support part 36 there is an outwardly or radially extending flange 44 of somewhat smaller diameter than the inside diameter of the barrel body 14 so as to provide clearance and freedom of movement of the plunger. It has been found that excellent results are provided by having the flange 44 approximately .001" to .002" smaller in diameter than the inside diameter of said barrel body 14.

From flange 44 there extends axially outwardly a re-

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duced diameter part 46 intermediate the ends of which there is a radially extending annular flange, indicated generally at 48, which may be termed the sealing flange. A peripheral portion of flange 48 is flared radially outwardly, as viewed in cross section, thereby providing a longitudinally lengthened peripheral part 50.

The outer peripheral surface 52 of the flange 48 is cylindrical, the diameter of said flange being the diameter of the interior bore of the barrel body 14 plus .001" to .003", depending upon the size of the syringe, the thickness of the unflared part of the flange 48, indicated at the double pointed dimension indicating arrow 54, and the length of the outer peripheral part 50 of the flange 48, the diameter of the flange 48 being the compression dimension.

The free end portion 56 of the reduced diameter part 46 extends forwardly of the flange 48 with the free end 58 of portion 56 in engagement with the inner side of the wall 16 to limit inward movement of the plunger when the latter is pushed fully inwardly. Thus the flange 48 is spaced inwardly of the wall 16 when said plunger is at its inward limit of movement.

A pressure member 60 is provided at the outer end of the plunger body, said member 60 being of any suitable material such as hard plastic or the like. Member 60 is pressed into the outer end portion of the plunger member 30 and secured therein by any suitable means such as an adhesive. Epoxy cement does very well for this purpose. At the outer end of the member 60 there is a radially extending annular flange 62 against which pressure is exerted by the user's thumb or other part of the hand when forcing the plunger inwardly. A relief passage 64 is provided lengthwise through the member 60 to relieve any undesired pressure within the member 30 which might otherwise develop or occur. It is to be noted that the outer surface of the flange 62 is also coated with "Teflon," the coating of said flange being done at the same time the member 30 is coated with this material.

The diameter of the portion 56 is substantially less than the diameter of the cylindrical bore or inside diameter of the barrel body 14 so that there is a generous clearance or space between the periphery of the portion 56 and the adjacent part of said barrel body bore. Thus the user will automatically read the scale 24 at the leading edge of the lengthened part 50 of the flange 48. This generous clearance also provides ready mixing and clean up of the syringe, which is especially important in getting uncontaminated samples of gas.

The end portion 56 also provides another advantage by spacing the flange 48 away from the closed end of the barrel. Since a portion of the closed end of the barrel is usually deformed a little, flange 48 is spaced away from the wall 16 sufficiently so that it does not enter this deformed barrel portion and operates in the undeformed portion of the barrel. Consequently, the flange 48 is at all times in sealing contact with such undeformed barrel portion. It is therefore possible to space the end of the scale adjacent the closed end of the barrel longitudinally away from the wall 16 and start the scale at a part of the barrel that is undeformed. Consequently extreme accuracy is possible because the scale is on only the undeformed part of the barrel body 14 and the flange 48 functions only in such part of the body 14.

The part 46 is of sufficiently reduced diameter so as to provide some flexibility to that part of the "Teflon" tip or head that extends forwardly of the inner end of the member 30. With such slight clearance any misalignment of the "Teflon" coated plunger will not cause leakage of fluid past, or damage to the sealing edges of the flange 48.

The diameter of the part 46, particularly that portion between the flanges 44 and 48, determines the width of the annular flange 48 between the cylindrical plane of the part 46 and the periphery of said flange and is important in connection with the sealing action of the sealing flange 48.

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When the plunger is pushed inwardly from an outer position, pressure is developed ahead of the sealing flange 48 which is exerted in the direction indicated by the arrow P, FIG. 3. This pressure causes the flange 48 to be urged rearwardly and results in a slight forcing backwardly or rearwardly of said flange 48, the greatest amount of this rearward movement being at the periphery thereof.

Viewing the head 34 in longitudinal section, as in FIG. 3, the flange 48 has what may be termed a rotational action about an indeterminate point at 68 in FIG. 3. This point actually indicates the general local region which serves as a fulcrum for said flange 48. Actually this fulcrum region is an annular region of the flange 48 which is determined by the width of said flange 48, the thickness of the flange 48 at 54 and the length of the outer surface 52 of the flange 48.

With rearwardly movement of the flange 48 there is a tendency of the outer part 50 to tilt but the entire peripheral, cylindrical surface 52 will remain in contact with the bore wall although the leading edge 70 of the peripheral part 50 is urged with increased force against said bore wall with increased pressure on the plunger thereby increasing the sealing action between said flange 48 and the bore wall.

The length of the peripheral surface 50 is sufficient so that fluid under the pressures developed in the use of the device will not blow by the sealing flange 48, but such surface should be relatively short in order to secure maximum unit pressure of the sealing part of the flange 48 against the wall of the bore in body 14, resulting from the rotating or pivoting action of the flange 48 from the region 68, as above described.

The thickness 54 of the flange 48 is sufficient to give firm compression of said flange against the inner surface or wall of the bore of the barrel body 14. The thicker the flange at 54, the greater the compression of the flange on the bore wall and the greater the resistance to movement of the plunger.

When the plunger is moved outwardly in the barrel body 14 suction on the front or inner surface of the flange 48 tends to cause a reverse rotation or pivoting at the region 68 with a corresponding but reverse action of the part 50 of the flange 48. In other words, the flange 48 is pulled toward the forward end of the barrel and the edge 72 is urged into tighter sealing engagement with the wall of the bore in barrel 14.

The length of the sealing life of the plunger is greatly increased by "thumbnail" spinning which will tilt the feather edges 70 and 72 and produce the shape of the edges 70 and 72 shown for the edge 70 in FIG. 5. In other words, a thumb nail or a finger nail is pressed against the edge 70 and the plunger rotated. The edge 72 may also be thus treated. After such spinning, these edges become highly effective sealing "rings" and may be repeatedly spun as necessary.

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 embodiment hereinbefore described being merely by way of example.

I claim:

1. A gas syringe, comprising: a transparent barrel including a cylindrical body having a cylindrical internal bore open at one end; a wall closing the opposite end; a tip extending outwardly of said wall and having a passage therethrough and communicating with the interior bore of the barrel body, said tip being for attachment of a hypodermic needle; a longitudinally extending scale on said body with the forward end thereof spaced from said opposite end so the entire scale extends over an undistorted part of the barrel; a radially extending flange at the open end of the barrel; a plunger assembly operatively disposed in the bore of the barrel body, said

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plunger assembly comprising a tubular member of stainless steel; a pressure member secured in the outer end of said tubular member and having a radially extending flange, said pressure member having a relief passage therethrough; a plastic coating on said tubular member and pressure member, the effective diameter of the coated tubular member being less than the diameter of said bore; a plastic head comprising an anchoring end part secured in the inner end of the tubular member by an adhesive, said anchoring part having a plurality of external annular recesses therein for reception of adhesive material; a cylindrical flange at the outer end of the anchoring part, said flange being disposed at the inner end of said tubular member and being of slightly smaller diameter than the diameter of the bore of the barrel body; a reduced diameter part extending axially forwardly of said flange, the diameter of said reduced diameter part being substantially less than the diameter of the bore of the barrel body; an annular flexible sealing flange on said reduced diameter portion intermediate the ends thereof, said sealing flange flaring radially adjacent the periphery thereof to provide a flared rim portion having a longitudinally extending cylindrical peripheral outer surface of such external diameter as to sealingly engaging the bore of the barrel body and having front and rear feathered edges, the forward end of the reduced diameter portion projecting ahead of the sealing flange a sufficient distance to space said sealing flange outwardly of the wall closing one end of the barrel body bore to thereby locate the sealing flange so that the forward edge thereof is in register with the adjacent end of the scale on the barrel when the plunger is at its inward limit of movement with the forward free end of the reduced diameter part in engagement with said end wall of the barrel.

2. A gas syringe comprising: a transparent barrel including a cylindrical body having a cylindrical internal bore open at one end; a wall closing the opposite end; a tip extending outwardly of said wall and having a passage therethrough and communicating with the interior bore of the barrel body, said tip being for attachment of a hypodermic needle; a longitudinally extending scale on the barrel with the forward end spaced from the closed end of said barrel; a radially extending flange at the open end of the barrel; a plunger assembly operatively disposed in the bore of the barrel body, said plunger comprising a rigid tubular member; a pressure member secured in the outer end of said tubular member and having a radially extending flange, said pressure member having a relief passage therethrough; a plastic coating on said tubular member and pressure member; a plastic head comprising an anchoring end part secured in the inner end of the tubular member; a cylindrical flange at the outer end of the anchoring part of slightly smaller diameter than the diameter of the bore of the barrel body; a reduced diameter part extending axially forwardly of said flange, the diameter of said reduced diameter part being substantially less than the diameter of the bore of the barrel body; an annular sealing flange on said reduced diameter portion intermediate the ends thereof, said sealing flange flaring radially adjacent the periphery thereof to provide a peripheral portion having a longitudinally extending cylindrical outer surface sealingly engaging throughout its length the bore of the barrel body and having thin front and rear edges, the forward end of the reduced diameter portion projecting ahead of the sealing flange a sufficient distance to space said sealing flange away from the wall closing one end of the barrel body bore to thereby locate the sealing flange so that the forward edge thereof is in register with the adjacent end of the scale on the barrel when the plunger is at its inward limit of movement whereat the forward free end of said reduced diameter part abuts said end wall of the barrel.

3. In a syringe: a barrel including a cylindrical body having a cylindrical internal bore open at one end; a

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wall closing the opposite end and having a part for attachment of a hypodermic needle; a plunger operatively disposed in the bore of the barrel body, said plunger including an elongated tubular member; a head of tetrafluoroethylene resin secured to the elongated tubular member at the inner end thereof; and an annular sealing flange of substantial width on said forwardly extending part, said sealing flange flaring outwardly and radially forwardly and rearwardly adjacent the periphery thereof to provide a flared rim portion having a normally cylindrical peripheral surface snugly engaging the bore of the barrel body and having thin front and rear sealing edges, said flange being somewhat resilient with the cylindrical surface extending continuously between said front and rear sealing edges.

4. In a syringe: a barrel including a body having a cylindrical bore open at one end; an end wall at the opposite end and having means for attachment of a hypodermic needle; a plunger operably disposed in the bore of said barrel body; a somewhat resilient head at the inner end of said plunger; a part at the forward end of the plunger of substantially smaller diameter than said bore; and an annular sealing flange having substantial width and flaring outwardly and radially forwardly and rearwardly adjacent the periphery thereof, the peripheral surface being normally substantially cylindrical said cylindrical surface, throughout its length, engaging the bore of the barrel body, there being thin front and rear sealing edges on said peripheral part.

5. In a syringe: a barrel including a cylindrical body having a cylindrical internal bore open at one end; an end wall closing the opposite end of said bore and having means for attachment of a hypodermic needle; a plunger operably disposed in the bore of said barrel body, said plunger including an elongated plastic coated member of somewhat smaller diameter than the diameter of said bore; a head of plastic material secured to the forward end of said member; said head having an annular stabilizing flange at the inner end of said member, said flange being of slightly smaller diameter than the diameter of said bore and of slightly greater diameter than said elongated member; a reduced diameter part extending forwardly of said flange; and an annular sealing flange on said reduced diameter part peripherally engaging the wall of said bore.

6. A plunger for a syringe, comprising: a tubular member of stainless steel; a pressure member secured in the outer end of said tubular member and having a radially extending flange at the outer end thereof, said pressure member having a relief passage therethrough; a coating of tetrafluoroethylene resin on said tubular member and pressure member; a head of tetrafluoroethylene resin comprising an anchoring part secured in the inner end of the tubular member by an epoxy adhesive, said anchoring part having a plurality of external annular recesses therein for reception of adhesive material; a cylindrical flange at the outer end of the anchoring part, said flange being disposed at the inner end of the tubular member and being of smaller diameter than the diameter of the bore in which it is to be operably disposed but of somewhat greater diameter than the coated tubular member; a reduced diameter part extending axially outwardly of said flange, the diameter of the reduced diameter part being a substantial predetermined distance less than the diameter of said flange; and an annular sealing flange on said reduced diameter part intermediate the ends thereof, said sealing flange being of greater diameter than the first mentioned flange and having an inner annular part of generally uniform thickness from which said flange flares radially outwardly to the periphery thereof to provide a flared rim portion having a cylindrical peripheral surface for sealing engagement with said bore, the forward and rear edges of the peripheral rim being relatively sharp and thin, the reduced diameter portion forwardly of the sealing flange extending a substantial predetermined

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mined distance ahead of the plane of the forward edge of said flange.

7. A unitary, plunger head for syringes of tetrafluoroethylene resin, comprising: a cylindrical anchoring part having at least one annular, external groove therein; a cylindrical, stabilizing flange at one end of said anchoring part and of greater diameter thereof but of somewhat smaller diameter than that of a bore in which the plunger head is adapted to be operably disposed; a reduced diameter part extending forwardly of said flange and being of substantially smaller diameter than said flange; and a resilient sealing flange on said reduced diameter part intermediate the ends thereof and of somewhat greater diameter than said stabilizing flange, said sealing flange having an inner annular part from which said flange flares radially outwardly to provide a flared annular rim portion having a normally cylindrical peripheral outer surface, the front and rear edges of said rim portion being relatively thin, said cylindrical surface extending between said front and rear edges, the reduced diameter portion ahead of said sealing flange extending a substantial predetermined distance forwardly of the plane of the forward edge of said rim portion.

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8. A plunger for syringes: a flange supporting part of substantially smaller diameter than the diameter of the bore of a syringe in which the plunger is to be used; and a resilient sealing flange on said part, said flange having an external portion normally cylindrical and a web connecting said portion to the supporting part, said web being of less thickness than the length of the cylindrical part and adapted to flex in an annular pivotal area substantially concentric with the cylindrical portion.

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