

United States Patent

[11] 3,566,859

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 [45] Patented **Mar. 2, 1971**

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[54] **VACUUM SYRINGE**
5 Claims, 14 Drawing Figs.

[52] U.S. Cl. **128/2,**
 128/218

[51] Int. Cl. **A61b 5/14,**
 A61m 5/22

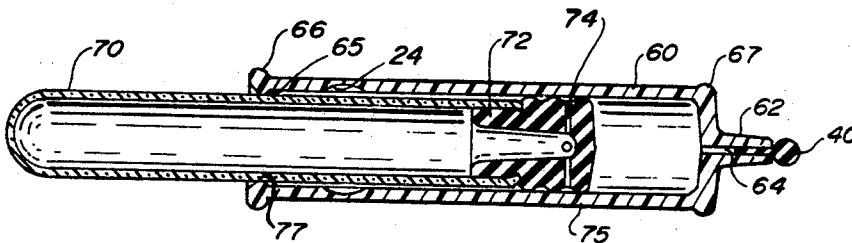
[50] Field of Search. 128/218,
 218 (M), 22 (D), 2; 251/205

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ABSTRACT: A syringe combination having an outer housing and a hollow plunger providing a pair of chambers of determined size. The plunger is provided with a piston having three or more spaced, ringlike sealing surfaces and with a fluid passageway from the interior of the plunger which is flow-connected to the outer piston surface and between ringlike sealing surfaces. The outer housing has one or more recesses of determined size formed in its inner surface with the recesses positioned near the open end of the housing and of a length so that the rearmost sealing surface of the plunger piston engages the housing between the recesses and the rear end of the housing when the flow-connection is brought into a fluid-conducting position with the recess.



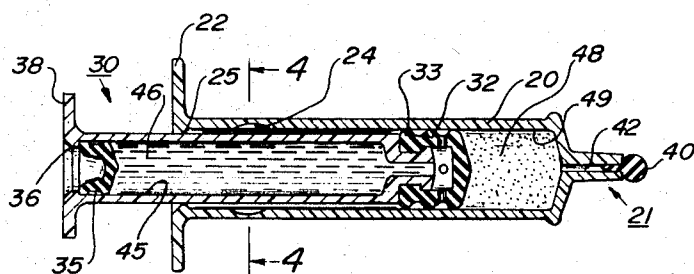


Fig-1.

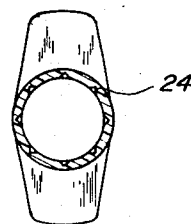


Fig-4.

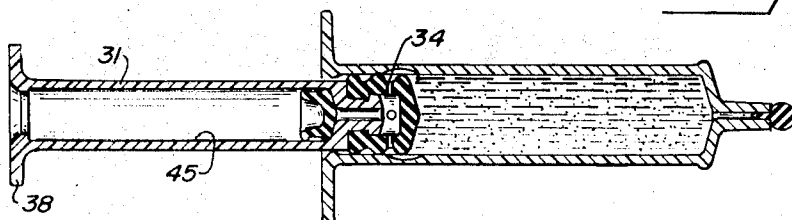


Fig-2.

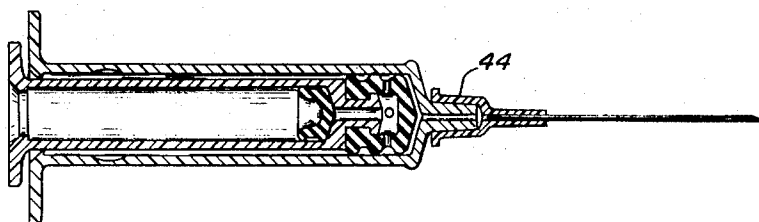


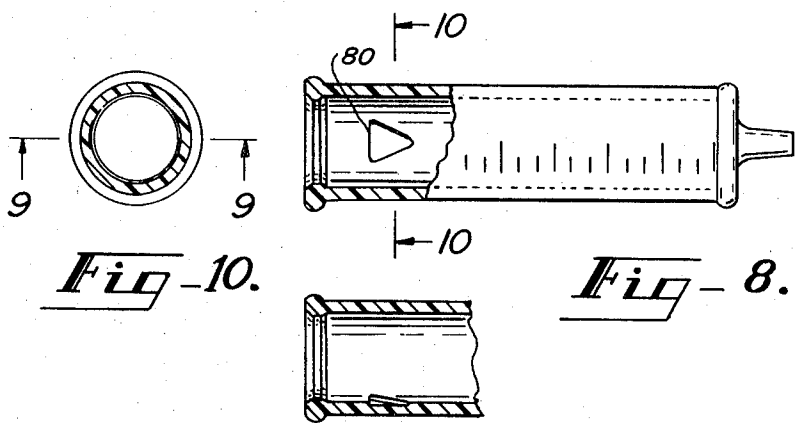
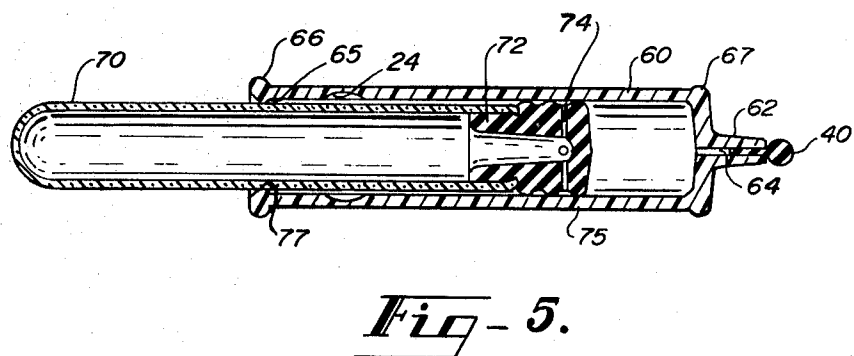
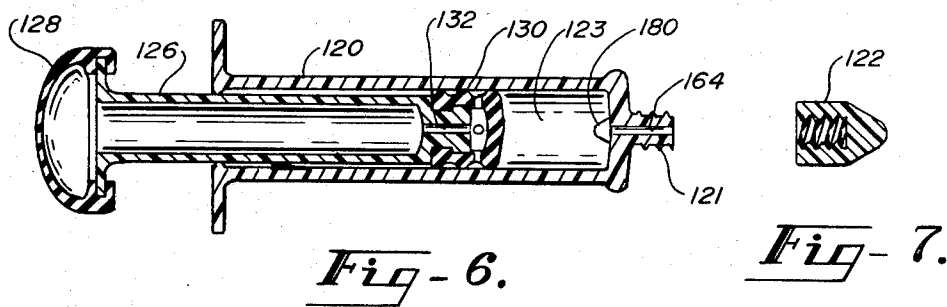
Fig-3.

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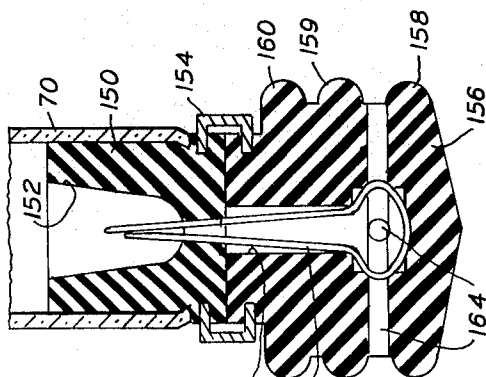


Fig-11

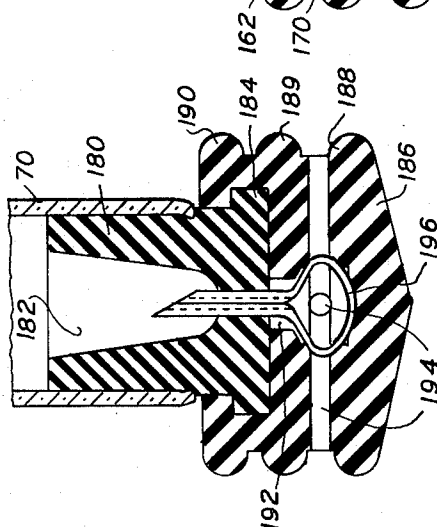


Fig-12

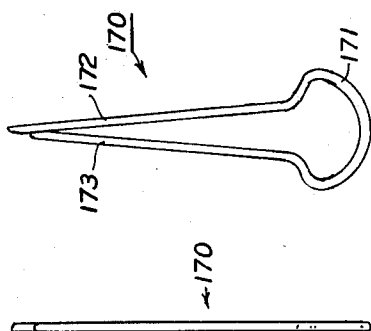


Fig-13

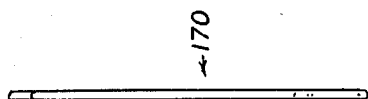


Fig-14

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VACUUM SYRINGE

REFERENCE TO RELATED APPLICATION

This Application is a division of application Ser. No. 645,264 filed Jun. 12, 1967 now U.S. Pat. No. 3,464,412.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the general class of surgery and more particularly to the subclass of syringes.

2. Description of the Prior Art

Syringes are well known in the general field of surgery and those for storing and intermixing various ingredients are represented in patents as to PIERICK, U.S. Pat. No. 3,279,654 of Oct. 1966; to BROWN, U.S. Pat. No. 2,591,046 of Apr. 1952; and to CAMBER, Great Britain No. 746,057 of Jan. 1959. These and other patents use gravity to induce a flow from one chamber to another. This method of transfer is often uncertain and sometimes is incomplete or requires an exact manipulation by the user who may not have the required skill or training. The precise and exact mixing of the various components comprising some of the new medicants is an absolute necessity. Ease of mixing by any potential administrator of the medicant is necessary and desirable, and an easily manipulative device is an object of this invention.

The syringe of present invention provides a means for bringing the interior of the housing of the syringe into a condition of reduced pressure, whereupon as a flow-conducting portion of a piston of a hollow plunger is brought into a fluid-passing or mixing position, the fluid which is preferably stored in the plunger is sucked from the plunger interior to flow to the housing chamber for a controlled mixing of the stored ingredients.

SUMMARY OF THE INVENTION

This invention provides a syringe-type apparatus having an outer housing of generally tubular construction which is formed with an open end and a closed end. This closed end has an aperture or passageway for the passage of medicants and the like which is usually to and through a needle. The plunger is slidable in the bore of the housing and is formed having a fluid-flow passageway extending from between a pair of ring-type sealing surfaces and to the interior of the plunger. The inner surface of the barrel portion of the outer housing has formed therein at least one recess of a determined length, width and depth and adapted to provide a fluid passageway from the interior of the plunger to and around one of the sealing rings and thence to the foreportion of the housing.

The other embodiment of the invention the syringe is intended to be used as a vacuum container in which the hollow plunger portion is a test tube which may be furnished with small predetermined quantities of various blood-treating fluids stored in the test tube. By manipulation, the test tube or plunger and the interior of the housing is caused to be brought into a condition of reduced pressure after which the plunger in the reduced pressure condition is moved to a storing position after which the interior of the housing is opened to the atmosphere to bring the interior of the housing to atmospheric pressure. At the time of use, the fore end or closed end of the housing has a needle mounted on a hub portion.

The apparatus with the needle attached is used as a syringe to withdraw a blood sample from the patient and to secure and store a determined quantity of blood within the syringe. After the desired amount of blood is drawn into the housing, the syringe is manipulated to draw the blood into the test tube. When the transfer of the blood to the test tube is completed the needle is discarded and the test tube may be moved fully into the housing for shipment to the laboratory. In other embodiments there are shown means whereby the test tube and housing may be separated with the test tube sealed with a rubber plug and the housing substantially closed with a rubber plug.

It is an object of this invention to provide a syringe apparatus in which the plunger is a test tube having a piston portion on its open end and adapted to slide within a housing so that the test tube may be brought to a condition of reduced pressure. The closed end of the housing is adapted to mount a needle for the drawing of blood from a patient and after the drawing of a determined quantity of blood into the housing this blood is transferred by manipulation of the plunger into the test tube for storage and transport.

There has been outlined rather broadly the most important features of the syringe apparatus of this invention in order that the present contribution to the art may be more fully appreciated. The chosen embodiments are provided for the purposes of illustration and description of the principles of this invention and are shown in the accompanying drawings forming a part of the specification wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents a sectional view of an intermixing syringe in which the components to be mixed are shown as stored in two separate compartments or members of the syringe;

FIG. 2 represents the syringe of FIG. 1 with the components brought into mixing relationship within the housing member;

FIG. 3 represents the syringe of FIG. 1 and showing a needle attached to the housing and the syringe after the contents have been expelled therefrom;

FIG. 4 represents a sectional view taken on the line 4-4 of FIG. 1 and showing one embodiment of a fluid bypass recess as formed in the outer housing member;

FIG. 5 represents a sectional view through an alternate embodiment in which the hollow plunger is a test tube;

FIG. 6 represents a sectional view through yet another embodiment in which the plunger outer end is provided with a resilient bulb and the plunger and housing are adapted for mixing and for dispensing of a medicant in the manner of a dropper;

FIG. 7 represents a sectional view showing an end closure or cap for mounting on the discharge end of the housing of FIG. 6;

FIG. 8 represents a side view of an outer housing with a portion of the sidewall broken away to show yet another form of a fluid bypass formed in the housing inner wall;

FIG. 9 represents a fragmentary and sectional side view of the fluid bypass of FIG. 8, the view taken on the line 9-9 of FIG. 10;

FIG. 10 represents a sectional view of the housing as taken on the line 10-10 of FIG. 8;

FIG. 11 represents a fragmentary sectional view of an alternate stopper and piston arrangement as mounted in the test tube member;

FIG. 12 represents a fragmentary sectional view of yet another alternate stopper and piston arrangement as mounted in the test tube member;

FIG. 13 represents a plan view of the needlelike member as used in the assembly of FIG. 11 and providing a flow passageway from the piston interior to and through the stopper; and

FIG. 14 represents a side view of the member of FIG. 13.

In the following description and in the claims various details will be identified by specific names for convenience; these names, however, are intended to be generic in their application. Corresponding reference characters refer to like members throughout the several FIGS. of the drawings.

The drawings accompanying, and forming part of, this specification disclose certain details of construction for the purpose of explanation of the broader aspects of the invention, but it should be understood that structural details may be modified in various respects without departure from the concept and principles of this invention and that the invention may be incorporated in other structural forms than shown.

DESCRIPTION OF THE SYRINGE OF FIGS. 1—4

Referring now in particular to the intermixing syringe shown in FIGS. 1 through 4, in which is shown an outer housing 20 of conventional configuration and including a reduced front end 21 sized so as to retain a needle on its outer tapered end. This housing has an open rear end with an outer flange portion 22 providing a shoulder or strap for the user's fingers. The interior diameter of this housing 20 is substantially round and constant with the exception of a portion near the rear in which is provided a fluid bypass in the form of outwardly extending scallops 24. These scallops are particularly seen in FIG. 1 and 4 and, as reduced to practice, are in the form of arcuate cuts approximately one-quarter of an inch long and with a depth and width of one-sixteenth of an inch at their maximum. At the rear end of the housing 20 it is to be noted that a small internal lip 25 is formed in order to provide a limit means or stop for the outward movement of a plunger member 30.

Referring now to the movable plunger member generally identified as 30, it is to be noted that a generally tubular portion 31 has a reduced front end upon which is fitted a piston plunger preferably of rubber and identified as 32. This piston plunger, in the preferred instance, is formed with three outwardly extending like-sized resilient ringlike portions 33. Between the front first and second ringlike portions 33 there is formed a fluid passageway 34 extending from the inner portion of the plunger to and through the outer peripheral surface of the piston.

At the open or rearward end of the plunger 30 (as seen in FIG. 1) there is carried a movable piston 35 slidable within the interior diameter of the barrel 31. This piston is sized to provide a fluidtight slip fit and, in the present instance, is formed with two outwardly extending ring portions adapted to provide a fluid sealing means as well as sliding surfaces. At the rear end of the tubular portion 31, it is to be noted that there is a small internal shoulder or lip 36 provided to prevent or limit the unwanted outer movement of the piston 35.

It is also to be noted that the rear end of plunger 30 is provided with a small grasping flange 38 for the easy gripping thereof by the fingers of the operator. Still referring to FIG. 1 it is to be noted that the reduced end of the outer housing 20 is provided with a vacuum or fluid seal in the form of a rubber or plastic plug 40 which is adapted to enter into a passageway 42 and seal this passageway both from the unwanted loss or entry of or plugging by powder and also to prevent the flow of air in and out of this passageway.

Referring next to FIG. 3, it is to be noted that a needle 44 is shown as mounted on the front end of the outer housing 20 after the plug 40 has been removed. This needle is of standard and conventional construction. After mounting on the syringe the insertion of this needle into the flesh or vein of the patient is in the manner of conventional practice.

DESCRIPTION OF VACUUM SYRINGE

Referring now to FIG. 5 and a syringe in which the plunger is a test tube and in which an outer housing 60 is similar to the housing 20 above described, this housing 60 is formed with a closed and reduced front end 62 sized to receive and retain a needle, not shown, but which may be the needle 44 (FIG. 3) above described. Within the front end of this housing is shown a plug 40 as previously described which plug seals a passageway 64 within the housing 60. The rear end of the housing is open and has a small internally formed lip 65 providing a stop means in the manner of lip 25 above. The outer portion of the housing 60 is formed with ribs 66 and 67 which provide means for easy grasping and retaining of the housing in the hands of the user.

Within this housing there is plunger member which, in this embodiment, includes a glass tube 70 whose open end is closed by a rubber stopper and piston combination 72. The rear or left end portion of the stopper-piston is sized to close and seal the open end of the test tube 70 while the foreportion

of any piston is formed with three fluid-sealing ring portions preferably substantially equally spaced. A fluid passageway 74 is provided between the first and second rings 75 reading from the right to the left as seen the FIG. 5 and a third ring adjacent the test tube provides an extended sealing means. The fluid passageway extends from the interior of the test tube to the outer surface between the first and second sealing rings.

In use, the test tube 70 may have stored within it one or more fluids or other materials used for making blood determinations. Among such materials are potassium oxalate; sodium heparin; lithium oxalate; sodium oxalate; potassium oxalate and sodium fluoride; ammonium oxalate or mixtures of the above, and mineral oil may be used for other determinations. The quantities and selection of material that may be combined within the test tube 70 is merely a suggestion of the various anticoagulants or other materials used for determining blood tests. These materials are now customarily provided in measured quantities in test tubes so as to be combined with blood at the time of taking of the blood sample specimens. The test tube, of course, in many tests is sterilized in the customary manner and has nothing in it and may be used for other tests. The storing of anticoagulants, etc., in a test tube for use in certain test determinations is not to be implied as novel but is illustrative of one use for this embodiment.

OPERATION OF THE TEST TUBE SYRINGE

It is contemplated that the syringe apparatus of FIG. 5 will be shipped assembled for use and with the stopper-piston portion 72 moved to the forward part of the outer housing 60 and with the plug 40 in an air-sealing relationship with the passageway 64. Whether the test tube 70 also contains anticoagulants and the like or not is merely a matter of selection as determined by the intended use of the syringe. Prior to the use of this assembly as a syringe the test tube is grasped and moved leftwardly until piston 72 approaches the rear of the housing and the passageway 74 is brought in the way of a fluid bypass in the housing. As the piston moves leftwardly the air in the housing expands so that reduced pressure is developed in the forepart of the outer housing 60. As the front ring 75 of the piston comes in the way of the fluid bypass, the reduced pressure in the housing is allowed to communicate itself to the test tube 70 to provide a determined vacuum or reduced pressure in the test tube. The test tube is then pushed forward or rightwardly into the closed position, whence, as the front sealing ring is moved forwardly of the bypass, the vacuum within the test tube 70 is maintained. The test tube is advanced forwardly into the forward end of the housing after which the plug 40 is removed and a needle is mounted on the reduced front end 62.

The needle may then be inserted into a vein and, in the manner of a syringe and with the test tube acting as the plunger, it is pulled rearwardly so that the piston 72 acts in a usual manner to draw blood from the vein. After the desired amount of blood is drawn within the outer housing 60 the plunger is stopped and the needle is withdrawn from the vein. The plunger then may be moved to provide an exact determination of the amount of blood within the forward portion of the housing 60, as for example, by expelling a small amount of blood through the needle. After the quantity of blood is provided in the housing portion, the test tube is pulled rearwardly until the passageway 74 of the plunger is brought in the way of the fluid bypass, whereupon the reduced pressure in the test tube causes the blood to be drawn from the housing 60 and into the test tube 70.

After the transfer of blood from the housing to the test tube is completed, the piston portion and test tube is pushed forwardly within the container housing 60 and in this condition the test tube with the outer housing 60 acting as a shield may be transferred to the laboratory for the determination of the blood test. At the laboratory, with the housing passageway 64 open, the test tube is drawn to the back end of the housing 60. The piston is moved past a shoulder 77 of the rear of the hous-

ing and is removed therefrom with the housing 60 being discarded. The stopper and piston portion 72 is drawn from the test tube opening and discarded after which the material in the test tube is tested in the usual manner. The test tube is preferably of conventional fire-resistant glass and after the test may be discarded.

It is to be noted in FIG. 8, 9 and 10, that a preferred fluid bypass as formed in the outer housing is a triangular shape recess which is embossed in only one portion of the interior surface of the housing. The housing may be the housing 60 of FIG. 5 with this embossure extending about one-quarter of an inch along the axis of the barrel and at its base at the rear of the housing being approximately one-quarter of an inch wide. The recess is preferably about ten or fifteen thousandths of an inch below the normal housing bore and generally throughout the triangular shape as shown. This fluid bypass provides the passage area generally necessary for the blood to be transferred from the housing to the interior of the test tube.

This triangular shape also provides a variable passageway whereby if the transfer to the test tube is to be very slow, the exposure of the forward ring to the triangular portion is made at the apex or forward end which is very small. When the piston is drawn further back its forward sealing ring portion is in the way of a larger portion of the bypass 80 and the blood or fluid will flow in a more rapid manner.

DESCRIPTION OF THE STOPPER-PISTON OF FIGS. 11, 13 AND 14

Referring next to FIGS. 11, 13 and 14 there is shown a two piece stopper-piston assembly which also may be used with the test tube 70 of FIG. 5. A stopper 150 is preferably made of rubber and, as shown, has a center relief 152 formed in one end so as to provide a closed other end of relative thinness. In the outer diameter of this stopper which is adapted to extend beyond the intumed end of the test tube there is formed one or more recess portions adapted to engage the inwardly extending leg portion of a clip 154. This clip may be in the nature of a wire staple or may be one or more band segments of arcuate configuration and selected length. The other leg portion of clip 154 is engaged in a recess formed in a rubber piston 156.

The outer surface of the piston has three ribs 158, 159 and 160 and the inner portion of the piston is provided with a bore 162 having an enlarged inner end. Transverse passageways 164 extend from the outer surface between ribs 158 and 159 to flow connect the outside of the piston to the bore 162.

A needlelike member 170 may be of metal or plastic and from a loop end 171 legs 172 and 173 converge to form a pointed other end. As seen in FIGS. 13 and 14 the member 170 is of relatively little width and when the loop end is inserted into bore 162 the protruding ends of the legs form a pointed member which may be pushed through the closed end of the stopper 150. The space between the legs 172 and 173 provide a flow passage from bore 162 to and into the relief 152. This flow passage becomes closed by the self closing action of the rubber as and after the member 170 is withdrawn from the stopper end.

Clip or clips 154 insure that the stopper and piston are retained in a contiguous flow sealing face-to-face relationship until these clips are removed. The removal of the clips is not accomplished until the test tube 70 (FIG. 5) has been drawn from housing 60 after which the clips may be easily removed with the piston 156 remaining in the housing to close the large end of the housing and the stopper 150 remains in the test tube 70 to seal the tube.

DESCRIPTION OF THE STOPPER-PISTON OF FIG. 12

Referring finally to the assembly of FIG. 12 there is shown a stopper 180 having a center relief 182 disposed to provide a closed end of relative thinness. The outer diameter extending beyond the end of test tube 70 is formed with an outwardly extending rib portion 184. A piston 186 having three outwardly

extending ribs 188, 189 and 190 has a shouldered recess formed in the open end of piston 184. This recess is sized to snugly engage and retain the stopper rib 184. Piston 184 has a bore 192 formed therein and this bore is flow-connected to the outside of the piston by means of transverse passageways 194 formed in the piston. The outer ends of these passageways terminate between ribs 188 and 189.

A needlelike member 196 is mounted with its loop end retained in bore 192. The legs of member 196 are contemplated as being arcuate in cross section facing and mating with the other to form a fluid passageway from the open loop to the other end which is beveled to provide a sharp point. This member 196 when pushed through the stopper provides a flow passageway from bore 192 to relief 182.

While the ribs of the piston 186 are in the housing 60 (FIG. 5) the stopper is retained in the piston by means of engaged rib 184. When the rib 190 has been brought outside the housing 60 the stopper may be tilted to cause the rib 184 to disengage from the piston and then needlelike member 196 is pulled from the stopper. The rubber in the stopper is sufficiently resilient to be self-sealing and when the needle is removed the stopper 180 seals the end of the test tube while piston 184 closes the large end of the housing 60.

Terms such as "left," "right," "in," "out," "fore," "rear" and the like are applicable to the embodiment as shown and described in conjunction with the drawings. These terms are merely for the purpose of description and do not necessarily apply to the various syringe embodiments shown and described and the manner in which they may be constructed or used.

The conception of the vacuum syringe and its many applications is not limited to the specific embodiments shown but departures therefrom may be made and without sacrificing its chief advantages and protection is sought to the broadest extent the prior art allows.

I claim:

1. A sampling syringe for the withdrawal and storage of blood and the like, the syringe including: (a) an outer housing of generally tubular configuration and having an inner bore of a generally constant cross section and with at least one bypass recess formed in the inner bore, said bypass recess positioned at a determined distance from and near an open rear end of the housing, the housing having a front partially closed other end and a passageway therethrough; (b) means for selectively closing the passageway of the partially closed front end of the housing so as to prevent the passage of air, fluids and the like; (c) a test tube of integral construction and having a closed rear end and having a main portion of generally tubular configuration, the test tube slidable in the bore of the outer housing, and (d) a resilient piston mounted in and closing the front end of the test tube, said piston having a plurality of ringlike sealing surfaces sized so as to be slidable in the bore of the outer housing while engaging said bore in a fluid-flow sealing manner, the piston having at least one fluid-flow passageway provided through the wall of the piston with one end of the passageway opening to the interior of the plunger and the other end terminating at the piston outer surface and between adjacent ringlike sealing surfaces, said sealing surfaces disposed to provide a sealing extent to the rear of the outer surface flow passageway termination of the piston so that when this passageway termination is brought in way of the housing bypass recess this sealing extent of the piston to the rear of the termination extends beyond the bypass and into the bore of the outer housing so as to seal the bore from any unwanted flow of air, fluid and the like from and to the open end of the outer housing.

2. A sampling syringe as in claim 1 in which the test tube is made of heat resistant glass.

3. A sampling syringe as in claim 1 in which the means for closing the passageway in the housing front end is a resilient plug of plastic, rubber and the like, the plug having a shank portion sized for removable insertion into and closing of said passageway, and the front end of the housing is formed with a

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hub portion adapted to receive and retain a needle, and in which the housing bore at its open end is formed with a small internal lip providing a stop shoulder engaged by the rearward ringlike sealing surface of the piston to position the piston axially in the housing bore so as to bring the flow passageway of the piston into a flow conducting relationship with the bypass recess in the housing.

4. A sampling syringe as in claim 1 in which the piston is a separate member and in which there is provided a separate plug to close the end of the test tube and in which there is pro-

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vided means for retaining the piston in an aligned and contiguous relationship to the plug during and while the test tube is in the housing.

5. A sampling syringe as in claim 4 in which the plug has a closed end and in which there is provided a needlelike member providing a portion of the flow passageway from the piston to and through the plug and to the interior of the test tube.

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