May 15, 1956 S. D. GOLDBERG 2,745,403

DISPOSABLE CARTRIDGE TYPE SYRINGE

Filed Oct. 14, 1954 2 Sheets-Sheet 1

Fig. 1.

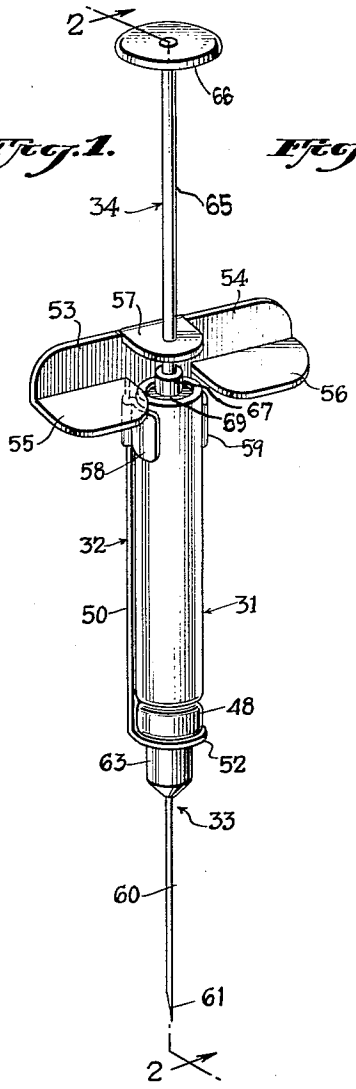


Fig. 2.

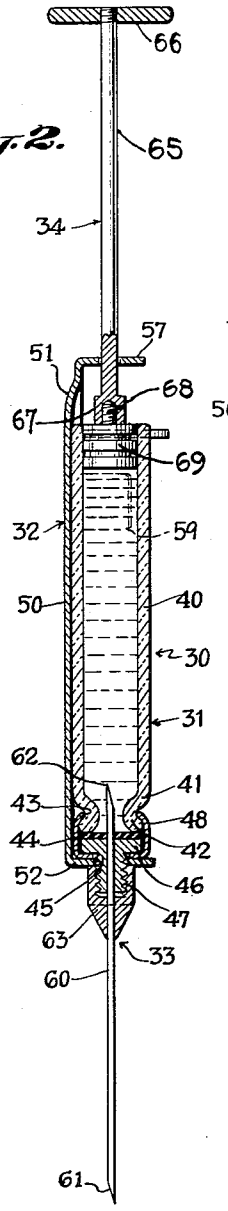


Fig. 3.

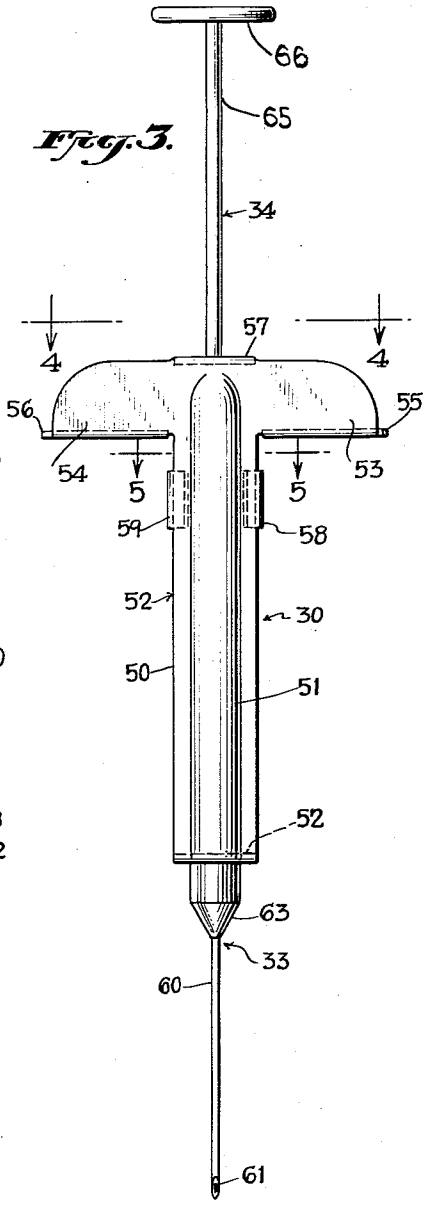


Fig. 5.

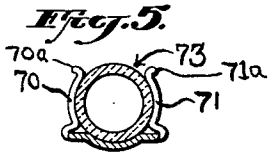


Fig. 4.

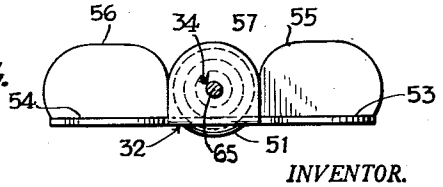
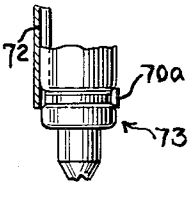


Fig. 6.



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May 15, 1956 S. D. GOLDBERG 2,745,403

DISPOSABLE CARTRIDGE TYPE SYRINGE

Filed Oct. 14, 1954 2 Sheets-Sheet 2

Fig. 7.

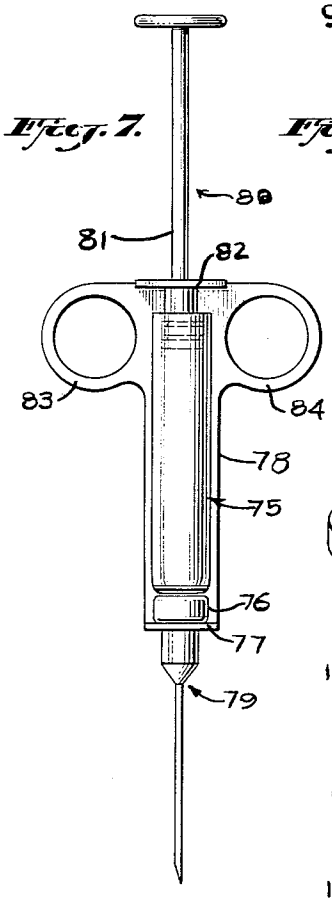


Fig. 8.

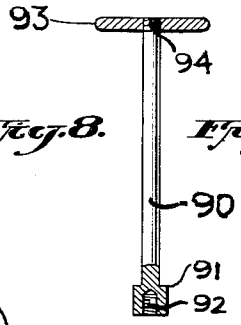


Fig. 9.

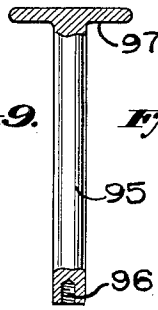


Fig. 10.

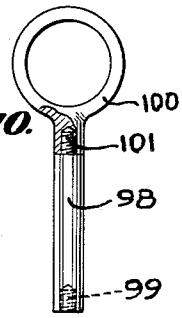


Fig. 11.

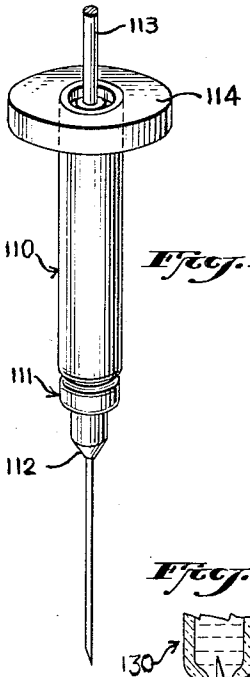


Fig. 14.

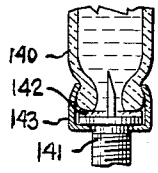


Fig. 15.

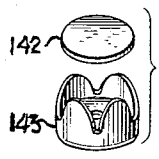


Fig. 16.

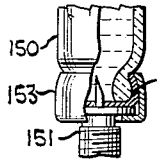


Fig. 17.

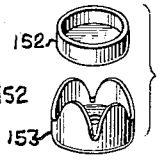


Fig. 18.

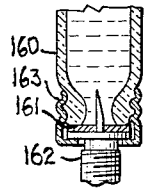


Fig. 19.

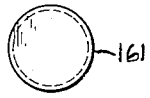


Fig. 12.

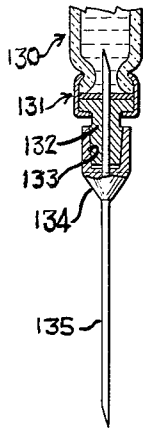


Fig. 13.

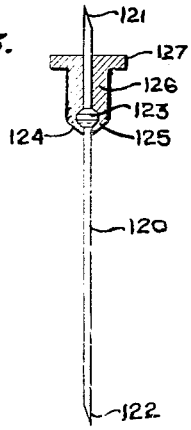


Fig. 20.

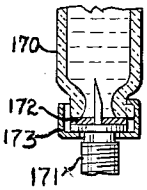
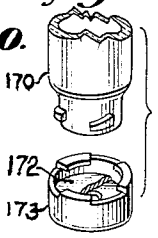


Fig. 21.



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United States Patent Office 2,745,403 Patented May 15, 1956

2,745,403

DISPOSABLE CARTRIDGE TYPE SYRINGE

Samuel D. Goldberg, West Hempstead, N. Y.

Application October 14, 1954, Serial No. 462,194

6 Claims. (Cl. 128—218)

This invention relates, generally, to improvements in hypodermic syringes of the type used in medicine for the parenteral injection of medicaments and the like, and, more particularly, it is concerned with a novel type of syringe that comprises a new form of disposable, single-dose, medicament-containing cartridge.

Heretofore, it has been known to provide hypodermic syringes comprising a hollow body or shell, adapted to receive and hold a specific type and size of conventional elongate, tubular, medicament-containing cartridge, means being provided and functioning in structural association with the body to support a hypodermic needle in communication with the cartridge interior and means being provided, too, for moving a piston within the cartridge whereby the contents of the cartridge may be expelled through the needle. The needle conventionally used with this type of syringe ordinarily is sharply pointed at both ends and is mounted intermediate its ends in a collar or ferrule which may be internally threaded or otherwise shaped to permit its engagement with a mating part of the syringe body whereby one end of the needle is caused to pierce a partial closure terminating one end of the cartridge and enter the interior thereof where the medicament is located. Usually, syringes of this type are breech-loading, i. e., the cartridge is inserted into the syringe body from the end opposite the end where the needle is mounted, and means, frequently in the form of an elaborate plug assembly engaging and coacting with the breech parts of the syringe body, is provided to force the cartridge as far as possible into the syringe body and toward the needle-bearing end thereof. The means for moving the piston within the cartridge also is mounted on and associated with this breech plug assembly and, in most types of syringes now commonly available, it consists of a freely slidable plunger, terminating at one end in a suitable handle and at the opposite end in means for engaging and moving the cartridge piston.

It will be understood that a hypodermic syringe must reflect, in its structural design, a proper appreciation of the conditions under which it is to be used, if it is to satisfy the fastidious requirements of the medical profession. It is essential, for instance, that the syringe be capable of easy cleaning and sterilization, hence no part of it can be made of any material that is incapable of being autoclaved without ill effects. Furthermore, the component parts of the syringe must have ruggedness sufficient to withstand normal handling and use and to permit the user to apply the very substantial forces required to move a thick, viscous medicament through a fine-bore needle, while not thereby making the instrument bulky and difficult to handle. Also, while lightness of weight and compactness of size and structural arrangement are desirable, these qualities must not be achieved at the expense of making the instrument less than fully responsive to the user's certain and positive control in situations requiring a refined delicacy of manipulation.

None of the types of hypodermic syringes utilizing disposable cartridges heretofore available has been wholly

satisfactory in each of the features above mentioned. Indeed, the prior art syringes characteristically have disadvantages frequently observed in devices that essentially are mere adaptations of previously known structures, modified for use with later developed accessory devices, in this instance, adaptations of the traditional or classic types of syringes, modified in structure for use with the later developed types of medicament-containing, single-dosage size, disposable cartridges. The inadequacies of these adaptations lie in their preservation of faults of previously known types of syringes while failing fully to exploit advantages that might be derived from using cartridge-packed forms of drugs or other substances.

For example, and this is one of the chief disadvantages of previously known types of cartridge syringes, these syringes individually have been adapted to use with merely a single form and dosage size of cartridge, hence it has been necessary for the physician to have available, both in the field and in his office, a whole series of syringes, adapted to accommodate cartridges of various sizes containing different dosages of medicaments. A syringe suitable for the administration of medicaments from cartridges having a volume of one cubic centimeter, for instance, would be structurally incapable of accepting longer cartridges of greater volume and would be functionally inoperative for use with cartridges of lesser volume.

This lack of adaptability of prior art types of syringes to use with cartridges differing slightly in length from that of the cartridges for which the syringes specifically were designed has created problems, also, in instances when it is desired to administer different forms of a medicament. For example, when charging a cartridge with a medicament or other substance in the form of an essentially homogeneous solution, an objective is to fill the cartridge chamber fully with no appreciable gas bubble trapped above the liquid. When, however, the medicament is in the form of a suspension or similar dispersion in an aqueous or oily vehicle, it is necessary that the cartridge contents be agitated immediately before administration to effect mixing of settled or stratified material throughout the vehicle and provide a homogeneous product for administration. To facilitate such mixing, it is usual, when charging the medicament into the cartridge, to leave a gas bubble entrapped with the liquid, thus, the volume required for a specific volume of suspension, with its gas bubble, exceeds that which, in a normal solution-filled cartridge, is required to contain an equal liquid volume of medicament. It follows, therefore, that cartridges containing suspension forms of medicaments normally exceed in length the cartridges containing an equal liquid volume of other forms of the medicaments. This slight additional cartridge length, in many instances, has prevented use of such cartridges interchangeably with standard types of prior art syringes.

A further disadvantage of these prior art types of hypodermic syringes is that they are comprised of a multiplicity of parts, each of which performs merely a single function; hence, necessarily, the syringes are very bulky, weighty and cumbersome to use. The complex and clumsy breech loading and piston actuating assemblies usually provided on these syringes are especially subject to this criticism, being comprised of a relatively large number of comparatively heavy, massive parts, including spring-pressed latching means and ponderous hinge elements for securing the assembly in operative position at the breech of the syringe barrel, which make the syringe costly to manufacture and, from the practical viewpoint of the physician, needlessly heavy and bulky.

Another disadvantage of at least many of the types of syringes heretofore available for use with cartridge-packaged medicaments is that when they are used with a cartridge of a slightly lesser length than that for which the

the syringe was designed, which easily might occur through accident or inadvertence, the cartridge at best merely imperfectly engages or, more usually, wholly fails to engage with that end of the needle provided to pierce the partial closure. When the syringe is being used for administering medicaments that are unsuitable for venous administration, this failure of the syringe can be of great importance because, usually, before administering the medicament, a test is made to assure that the front needle point is at the desired location in tissue, not in a vein, which is done by retracting the syringe plunger and observing if venous blood is drawn into the syringe; then, if the needle point is deemed to be in the correct position, the piston is forced forward, causing the medicament to be injected into the patient. It will be apparent that, if the cartridge becomes disengaged from the needle upon attempted retraction of the cartridge piston, the administering physician has no means of knowing if the needle point is or is not in a vein and, if he acts upon the apparently valid assumption that it is not, when, in fact, it is so positioned, the possibility exists of venous administration of a medicament unsuited for this use, which may be attended with fatal results for the patient.

One of the chief objects of this invention is to provide a light yet sturdy hypodermic syringe that is comprised of a minimum number of coacting elements in association with a medicament-containing cartridge, free of the disadvantages of prior art syringes above mentioned, and that may be manufactured by methods of mass-production at a cost inappreciably higher than disposable cartridges of the types now available.

Another object of this invention is to provide a novel form of hypodermic syringe, characterized by simplicity of structure and ease of manufacture, that comprises a new type of disposable, single-dose cartridge as an essential and principal structural and functional element.

A further object of this invention is to provide a novel form of disposable cartridge, suitable for containing single-dose portions of medicaments and the like, adapted to being directly coupled to a double-pointed hypodermic needle, and, when associated with a piston actuating means and a suitable finger grip, to constitute a completely functional hypodermic syringe.

Another object of this invention is to provide a partial closure for disposable, single-dose size, medicament-containing cartridges, provided with means, structurally substantially permanently integrated therewith, to engage with and serve as mounting for a double-pointed hypodermic needle communicating, through said partial closure with the interior of the cartridge.

A further object of this invention is to provide a cartridge type hypodermic syringe in which the cartridge is held in a positive relationship in association with a syringe needle whereby accidental disengagement of the cartridge and needle upon retraction of the cartridge piston is substantially precluded.

Other objects of the invention will be apparent hereinafter to those skilled in the field to which this invention relates as the detailed description of various presently preferred embodiments of the invention proceeds.

In accordance with certain aspects of this invention, a disposable cartridge is provided, suitable for containing single dosages of medicaments and the like, comprising an elongate, tubular body portion of substantially uniform bore, thickened and partially constricted near one end and provided there with an annular groove, formed on the outer surface of the tubular body and adapted to engage with a closure collar element; an imperforate disc, adapted to being easily pierced by a hypodermic needle and formed of resilient, liquid impervious material, substantially inert toward and insoluble in liquids, solvents and medicaments commonly administered by injection, positioned normal to the axis of said tubular body portion and overlying the opening in the partially constricted end thereof; an essentially cylindrical hub element having an axially

located opening extending therethrough, provided at one end with a radially extending, annular flange, disposed coaxially relative to the tubular body portion with its flanged end against the outside surface of said disc; means on said hub element to engage with and support a double-pointed hypodermic needle with one end of said needle extending through the hub opening and piercing said disc; a closure collar element around the flanged end of said hub element and engaging with the annular groove formed on the tubular body end, pressing the disc therebetween to provide a liquid-tight partial closure at the end of the cartridge; and a movable piston, within the tubular body portion, embracing the walls thereof to provide a liquid-tight closure at the open end of the tubular body portion.

In accordance with certain other aspects of this invention, a hypodermic syringe is provided comprising a disposable cartridge as above described; piston actuating means comprising a plunger member engaging said piston in a manner permitting movement of the piston axially within the tubular body portion in either direction at choice; an outwardly extending finger grip attached to the tubular body portion in a manner such that movement of the body portion axially relative to the finger grip is precluded; and a double-pointed hypodermic needle, engaged with and supported on the hub element, disposed with one of its ends extending through the axial opening in the hub element and piercing the resilient disc.

To facilitate a fuller and more complete understanding of this invention and of how the principles thereof best may be applied to provide an improved cartridge-type syringe, reference now is made to the figures of the accompanying drawing, illustrating certain presently preferred embodiments of this invention, wherein like reference characters or numerals designate the same structural element or feature, and wherein:

Figure 1 is substantially a front view, in perspective, of a hypodermic syringe according to the preferred embodiment of this invention;

Figure 2 is substantially a longitudinal sectional view of the syringe illustrated in Figure 1, taken along the line 2—2 thereof;

Figure 3 is substantially a rear elevational view of the syringe illustrated in the foregoing figures;

Figure 4 is substantially a lateral sectional view of the syringe illustrated in the foregoing figures, taken along the line 4—4 of Figure 3;

Figures 5 and 6, respectively, are a partial lateral sectional view and a fragmentary side elevational view of a structurally modified form of the syringe illustrated in the foregoing figures;

Figure 7 is substantially a front elevational view of another structurally modified form of the syringe illustrated in Figures 1 through 4;

Figures 8, 9 and 10 substantially illustrate alternative plunger elements that may constitute parts of hypodermic syringes embodying the principles of this invention;

Figure 11 is substantially a front view, in perspective, of another embodiment of this invention;

Figures 12 and 13 are fragmentary sectional views of a portion of a syringe according to this invention, illustrating modifications of the needle mounting means;

Figures 14 and 15, respectively, are a fragmentary enlarged detail view and a detail perspective view of an alternative form of cartridge partial closure that may constitute a part of a hypodermic syringe according to this invention;

Figures 16 and 17, respectively, are a fragmentary enlarged detail view and a detail perspective view of another alternative form of cartridge partial closure;

Figures 18 and 19, respectively, are a fragmentary enlarged detail view and an outer end view of yet another alternative form of cartridge partial closure; and

Figures 20 and 21, respectively, are a fragmentary enlarged detail view and a perspective fragmentary view of still another alternative form of cartridge partial closure.

Referring now particularly to Figures 1, 2, 3 and 4 of the drawings, wherein a hypoderic syringe according to the now most preferred embodiment of this invention is illustrated, it will be noticed that the syringe, generally indicated by the reference numeral **30**, comprises a medicament-carrying cartridge, generally designated **31**, mounted in a frame, generally indicated by the numeral **32**, by means including a needle-carrying ferrule or bushing, generally designated **33**, and a cartridge piston actuating means, generally indicated by the reference numeral **34**.

The medicament-carrying cartridge **31** comprises an essentially straight, tubular body portion **40** of substantially uniform bore, which may be a length of ordinary glass tubing, open at one end and terminating, at its opposite end **41** in a somewhat thickened and partially constricted formation **42**, provided, on its outer surface, with an annular groove **43**. An imperforate disc **44**, formed of resilient, liquid impervious, easily pierced material, capable of being sterilized and substantially inert toward and insoluble in liquids, solvents and medicaments normally parenterally administered by injection, is positioned against the thickened end portion **42** of the cartridge body **40**, susbtantially as shown. It will be understood that this disc, which is held tightly against the cartridge body by means to be hereinafter described, serves as a so-called partial closure for the medicament-containing cartridge, and that the disc is formed of a material so selected to admit of being pierced readily by a hypodermic needle for purposes of withdrawing medicament from the cartridge chamber, as will be described later. Among the materials that may be used for this purpose and from which the disc may be fabricated readily are natural or synthetic sheet rubber, sheeted synthetic rubber-like elastomers, composite laminated sheets comprising the foregoing and which may include a metal foil layer in the laminate, and the like. It will be understood that the thickness and other dimensions of the disc are such that it may be readily pierced by a needle when positioned at the cartridge mouth without being forced into the cartridge interior thereby.

A substantially cylindrical hub element having an axially located opening formed therein and extending therethrough, provided with an integral, radially extending, annular flanged end portion **46** and with threading **47** extending along its shank portion, is positioned coaxially relative to the tubular body portion **40** with its flanged end portion against the outer face of the disc **44**, essentially as shown, and a substantially tubular closure collar element **48**, turned in at its ends, is disposed around the flanged end portion **46** of the hub **45**, around the disc **44** and the end portion **41** of the tubular cartridge body **40**, being seated in and engaged with the annular groove **43** formed therein, whereby these parts are held together firmly and permanently under compressive forces providing a liquid-tight closure across the mouth of the cartridge.

The frame **32**, preferably formed of bent, stamped sheet metal, is of a generally T-shaped configuration, comprising an elongate body portion **50**, provided with a longitudinally extending bent-up strengthening rib **51**, terminating at one end in a first pierced lug **52**, integrally formed with the frame body portion and extending across the end thereof, disposed substantially normal to the body portion **50**. At the opposite end of the frame body portion **50**, two integrally formed, oppositely extending arms **53** and **54** are provided, bent-up at the bottoms thereof to present finger grips **55** and **56**, respectivley, substantially as shown, and, intermediate the tops of these arms, a second pierced lug **57** is provided, also disposed normal to the frame body and extending in the same directional sense as the first pierced lug, the openings in said lugs being substantially aligned relative to an axis essentially parallel to the frame body portion.

Two facing, oppositely bent lugs **58** and **59**, integrally

formed with the frame body portion **50** and extending from the frame in the same directional sense as the pierced lugs **52** and **57**, are provided near the frame arms, essentially as shown. Each of these lugs **58** and **59** is provided, near its distal end portion, with a reverse bend to facilitate its gripping and embracing of the cartridge body as will now be described. The medicament-carrying cartridge **31** is placed in the frame **32** with the threaded shank portion **47** of the hub element **45** extending through the opening in the first pierced lug **52**, and with the lugs **58** and **59** embracing the opposite or distal end of the cartridge body, essentially as shown. It will be understood that, when so positioned, the longitudinal dimensions and proportions of the frame body are such that there is adequate spacing between the second pierced lug **57** and the near end of the medicament-carrying cartridge to allow adequate accommodation of cartridges of substantially differing lengths and containing substantially different volumes of medicament.

The needle, generally indicated by the reference numeral **33**, comprises an elongate, tubular cannula **60**, pointed at both its ends, **61** and **62**, to facilitate piercing epidermal flesh and the cartridge partial closure disc **44**, respectively, rigidly mounted, at a position intermediate its ends, in an internally threaded ferrule or bushing **63**, which is received on and engages with the threaded shank portion **47** of the needle hub element **45**, essentially as shown in Figures 1, 2 and 3 of the drawings. It will be observed that engagement of the needle-carrying ferrule **63** with the needle hub element **45**, while a portion of the needle or cannula end is positioned within the axially extending bore or opening in the hub element results in the needle end portion **62** being caused to pierce the disc **44**, whereby the medicament in the cartridge may be discharged through the needle. Also, when these elements of the syringe according to this invention are thus interengaged, the needle and the cartridge, in effect, are structurally integrated with the frame, assuring rigidity of the needle relative both to the frame and the cartridge, and, further, assuring that longitudinal axial motion of the cartridge relative to the needle or the frame effectively will be precluded.

The cartridge piston actuating means **34** comprises a rod-like shaft or plunger element **65**, freely slidably mounted in the opening formed in the second pierced lug **57**, terminating, at one end, in a hand grip or head formation **66** and, at its opposite end, in a piston-engaging formation **67**, provided with an internally threaded, axially extending opening capable of being threadably engaged with a stud **68**, provided with mating threading, axially mounted in and extending outward from the piston **69**, substantially as shown. The engagement of the plunger end portion **67** with the piston stud is such, it will be noticed, that the piston may be moved axially within the cartridge in either direction at choice.

It will be understood that the piston **69**, which may be formed of rubber or other material having the characteristics set forth above in connection with the description of the disc **44**, tightly embraces the interior walls of the cartridge body portion **40**, whereby it effects a liquid-tight closure thereof, and that motion of the piston axially within the cartridge body toward the needle-bearing end of the cartridge can cause medicament within the cartridge to be expelled therefrom through the needle.

It is to be noticed, in connection with this embodiment of the present invention, that, as both end portions of the cartridge are connected to or engaged with elements of the frame, and the plunger rod **65**, slidably mounted in an opening in a lug also constituting an element of the frame, is coupled with the piston in a manner precluding movement except along the axis of the cartridge, the elements of the syringe coact to provide an instrument allowing of delicate manipulation and affording the user constant, positive control throughout the injection of the medicament.

Referring now particularly to Figures 5 and 6 of the drawing, it will be noticed that here a modified form of means for strucutrally integrating the needle-bearing cartridge end with the frame is illustrated in fragmentary views wherein merely these portions of the syringe are represented. In this modification, which functionally is substantially the equivalent of the first lug **52** in the first-described embodiment of the invention, a pair of facing arms, **70** and **71**, is provided upon and integrally formed with the frame end portion **72**, the arms being bent back at their distal end portions **70***a* and **71***a*, respectively, to assist in gripping and tightly embracing the cartridge end portion, generally indicated by the reference numeral **73**, essentially as shown. It is to be observed, particularly, in this modified form of the syringe according to this invention, that the arms are so proportioned and shaped that they grip the cartridge end in the vicinity of the annular groove formed in the syringe body, thereby effectively holding the cartridge against movement axially during use of the syringe.

Reference now is made to Figure 7 of the drawing wherein another modification of hypodermic syringe frame structure is illustrated. In this modification, a syringe cartridge, generally designated **75**, is provided with a partial closure, generally indicated at **76**, which is engaged with an opening in a first pierced lug **77** at one end of the central frame body portion **78**, being retained in such engagement by a needle assembly generally designated **79**, all substantially in the manner and for the purposes described hereinabove in connection with that embodiment of this invention which is illustrated in Figures 1, 2, 3 and 4 of the drawing. Also in like manner, this modified form of syringe is provided with a cartridge piston actuating means, generally designated **80**, comprising a plunger rod **81**, slidably mounted in a second pierced lug **82**, provided on the frame **78**, and engaging with a piston within the near cartridge end portion, for the purposes and with the results that have been set forth above when describing the other embodiment of this invention. However, in this modified embodiment of the invention, the frame **78** is provided with two essentially flat, integral annular formations, **83** and **84**, located intermediate the first and second pierced lugs, **77** and **82**, respectively, disposed in substantially a common plane with the frame body portion **78** and extending in opposite directions therefrom to provide the finger grip of the syringe. This modified type of finger grip is especially preferred for use in those instances, such as the venous administration of medicaments, where an initial retraction of the cartridge piston is necessary, as this form of grip may be engaged with the user's fingers, thereby permitting one-hand operation of the instrument.

In Figures 8, 9 and 10, three structural modifications of the cartridge piston actuating means are represented. The means represented in Figure 8 is substantially that utilized in those embodiments of this invention that have been described above, and comprises a rod-like shaft **90**, terminating, at one end, in a radially enlarged formation **91** in which is provided an axially extending threaded opening **92** for engagement with a piston stud, and, at its opposite end, bearing a substantially round, flat, disc-shaped hand grip **93**, mounted on the end of the shaft **90** by means including interengaging threads **94**. The enlarged formation at the end of the shaft prevents accidental disengagement of the shaft from the opening in the pierced lug in which it is mounted, thereby assuring that it will be with the syringe frame when needed for use.

The piston actuating means illustrated in Figure 9 of the drawing is a modification of that above described and it comprises a rod-like shaft **95**, provided with a threaded opening **96** at one end for engagement with a cartridge piston stud, and at its opposite end, being provided with an integrally formed, radially extending, disc-like hand grip, substantially as shown. This modified form of hand grip, it will be noticed, is not provided with a stop formation at the piston engaging end, hence it may be withdrawn freely from its engagement with a pierced lug in which it may be mounted.

The modified hand grip structure represented in Figure 10 is particularly suited for use in syringes intended to be employed in the administration of viscous liquids or in instances where it is necessary to move the piston alternately in opposite directions as a normal incident of administration, for this grip, and especially when it is used in conjunction with the type of finger grip shown in Figure 7 of the drawing, may be readily engaged with the user's fingers, thereby facilitating its operation. This grip comprises a rod-like shaft element **98**, provided, at one end, with a threaded opening **99** for engagement with a like-threaded stud on a cartridge piston, and, at its opposite end, with a grip **100**, generally annular in form and connected to the shaft by suitable means such as an interengaging threading **101**.

The alternative embodiment of the hypodermic syringe according to this invention illustrated in Figure 11, because of its extreme simplicity of structure, is of major commercial significance. This embodiment of the invention comprises a cartridge, generally designated **110**, terminating in a partial closure, generally indicated by the reference numeral **111**, bearing a double-pointed hypodermic needle assembly **112**, rigidly mounted upon an outwardly extending stud element forming a part of the partial closure. Suitable cartridge piston actuating means, engaged with a piston, is provided, of which merely a plunger shaft **113** is shown, part of which is broken off to facilitate clearness of illustration. It will be understood that all of these elements of the syringe may be substantially as described above in connection with the other embodiments of this invention, but differing from these other embodiments, in this syringe the finger grip **114** is comprised of an annular structure, attached to the cartridge end distal from the partial closure, having a relatively substantial radial thickness and being, also, of adequate thickness axially to serve its intended purpose. This annular finger grip may be attached to the cartridge barrel by suitable adhesive or the like, or it may be retained in its operative position by force-fitting it in place, then depending upon coacting frictional and compressive forces to retain it in its position. Regardless of the manner whereby the finger grip is attached to the barrel, it will be understood that it is attached in a manner that substantially precludes relative axial movement of these two syringe members under those conditions ordinarily encountered during use of the syringe.

Reference now is made to Figures 12 and 13 of the drawing wherein alternative means for supporting the hypodermic needle in functional relationship to the other syrings elements are illustrated. In Figure 13, a cannula **120**, sharply pointed at its ends **121** and **122** and provided with a bead **123** rigidly mounted on and permanently attached to the cannula at a location intermediate its ends, is shown engaged with its mounting means. The mounting means comprises a plurality of axially extending, coacting resilient fingers, two of which are designated **124** and **125**, integrally formed with a hub element **126**, which is provided with a flanged end portion **127** and which has an axially located opening extending therethrough. The needle is engaged with its mounting means by introducing the needle end **121** into the opening formed in the hub element, then forcing it further into the hub until the fingers are firmly frictionally engaged with the bead carried on the cannula, substantially as shown. It will be understood that when utilizing this modified form of double-pointed needle and needle mounting means in a hypodermic syringe according to this invention, the hub element **126**, unassociated with the needle, is substituted for the hub element of the cartridge partial closure, i. e., for the hub element **45** in that embodiment of the invention that is illustrated in Figure 2 of the drawing and

described above. When it is desired to use a so-modified type of syringe, the needle is positioned with its end in the opening of the hub, then it is pushed axially toward the piston bearing end of the cartridge, causing its near pointed end to pierce the disc element of the partial closure and, also, causing the needle bead to spread the resilient finger portions of the hub and be firmly frictionally embraced and held thereby.

In the modified form of needle mounting means illustrated, in a fragmentary sectional view, by Figure 12 of the drawing, a cartridge end portion, generally designated **130**, is provided with a partial closure, generally indicated by the reference numeral **131**, comprising a flanged, axially bored, hub element **132**, tapered along its outer surface **133**, upon which is received, in frictional engagement therewith, a similarly but reversely tapered cap or ferrule **134**, bearing a double-pointed hypodermic needle **135**. The manner whereby the needle end is passed through the hub bore and caused to pierce the resilient disc element of the partial closure on the cartridge, and the ferrule is frictionally engaged with the tapered shank of the hub element will be obvious without detailed description.

Referring now to Figures 14 through 21 of the drawing, various modifications of the cartridge partial closure elements will now be described, it being understood that any of these modified closures, at choice, may be substituted for the partial closures above described without departure from this invention.

The modified closure represented in Figures 14 and 15 of the drawings, represented here in position upon an end portion of a cartridge body **140**, comprises a hub element **141**, disposed coaxially relative to the cartridge axis, a resilient disc element **142** interposed between the end of the cartridge body and a flanged end portion of the hub element, and a collar **143**, disposed around and engaging the flanged portion of the hub element and being provided with axially extending petals that may be bent inwardly to engage with an annular groove formed in the end portion of the cartridge body, whereby the disc is caused to press against and seal the end of the cartridge, substantially as shown. It will be understood, of course, that in this representation of this modified closure in Figure 14 of the drawing, and this is true, also, of the closure modifications represented in Figures **16**, **18** and **20**, hereinafter described, merely the point of the needle piercing the disc is shown, the remainder of the needle, the ferrule upon which it is carried and even a portion of the hub element, in each instance, being omitted for clearance of illustration.

The modified partial closure shown in Figures 16 and **17**, comprising an end portion **150** of a cartridge body, a hub element **151**, a resilient member **152**, and a collar **153** which engages the flanged hub end and presses it, with the disc therebetween, against the end of the cartridge body, differs from the partial closure modifications above described in that the resilient member is formed in a cup shape that it may the better seal the cartridge end and provide a larger area under pressure of the collar member than is provided by a disc-shaped resilient element.

The modified partial closure represented in Figures 18 and 19 of the drawing, shown in position upon an end portion of a cartridge body **160**, comprises a resilient disc **161**, which may be thickened at its marginal portions as indicated in Figure 19, a hub element **162** resting against the disc, and a collar member **163**, engaging a flanged end portion of the hub element, pressing the resilient disc against the end of the cartridge body to seal the same, and engaging annular grooves or threading formed on the surface of the cartridge body, whereby the closure is maintained tightly sealed despite rough handling of the cartridge. This type of closure is especially advantageous for use in instances where the integrity of the partial seal must be maintained against abuse in the handling of the cartridge or against extremely powerful forces acting upon the liquid medium within the cartridge, for instance, when the medicament is a viscous liquid requiring high pressure to force it through the fine bore of the needle. The advantage of this closure is that it affords an unusually firm and rugged engagement between the closure collar member and the end of the cartridge body, with the attendant advantages mentioned.

The modified form of partial closure illustrated in Figures 20 and 21, shown mounted upon an end portion of a cartridge body **170**, comprises a hub element **171**, a resilient disc member **172** and a collar member **173** which, embracing a flanged end portion of the hub element, presses said element, and the disc therebetween, against the end of the cartridge body, essentially as shown. It will be noticed that the collar member, in this modified form of partial closure, engages with cam-like formations on the cartridge body, whereby the elements and members are pressed together tightly to provide the desired liquid-tight seal at the cartridge end.

It is again to be emphasized that the novel hypodermic syringes according to this invention, by reason of their simplicity of structure and the manner in which the syringe elements coact to provide all needed functions with a minimum of structure, are especially suited to mass-production by automatic machinery such as now is used for making disposable cartridges of the ordinary types, and, under these conditions, the complete syringe is inappreciably more costly to make than the cartridges, hence, too, they are disposable.

Having thus described the subject matter of this invention, what it is desired to secure by Letters Patent of the United States is:

1. A disposable hypodermic syringe comprising: (1) a cartridge that comprises an elongate tubular body of substantially uniform bore, open at one end, partially constricted and provided with an annular grooved formation on the outer surface near the other end thereof; a piston, positioned within the open end of the tubular body and capable of movement axially therein, engaging the inner walls thereof to provide an essentially liquid-tight closure therefor; and a partial closure at the opposite end of the tubular body, said partial closure comprising a disc-shaped member, formed of resilient material capable of being pierced by a needle, adapted to overlie the opening of the partially constricted end portion of the tubular body; an essentially cylindrical hub element having an opening extending axially therethrough, provided with a radially extending flanged portion at one end thereof and, at the other, with means for engaging and supporting a double-pointed hypodermic needle while one end of said needle is positioned in the axially extending opening and projects therethrough from the flanged end thereof, said hub element being adapted to being positioned with its flanged end portion against the resilient member and its axis substantially coincident with the axis of the body portion of the cartridge; and a collar member, disposed around the flanged end portion of the hub element, the resilient disc-shaped member and the tubular body end portion in engagement with the annular grooved formation thereon, pressing these parts axially together, whereby the resilient member is held as a liquid-tight seal against the end of the tubular body; (2) a double-pointed hypodermic needle engaged with and supported on said hub element with one end thereof extending through the axial opening therein and piercing said disc-shaped resilient member; (3) piston actuating means engaged with said piston and permitting controlled axial motion of the piston in either direction at choice; and (4) a finger grip member, located near the open end of the tubular cartridge and attached to the cartridge in a manner substantially precluding axial movement of the cartridge relative to the finger grip member.

2. A disposable hypodermic syringe comprising: (1) a cartridge that comprises an elongate tubular body of

substantially uniform bore, open at one end, partially constricted and provided with an annular grooved formation on the outer surface near the other end thereof; a piston, positioned within the open end of the tubular body and capable of movement axially therein, engaging the inner walls thereof to provide an essentially liquid-tight closure therefor; and a partial closure at the opposite end of the tubular body, said partial closure comprising a disc-shaped member, formed of resilient material capable of being pierced by a needle, adapted to overlie the opening at the partially constricted end portion of the tubular body; an essentially cylindrical hub element having an opening extending axially therethrough, provided with a radially extending flanged portion at one end thereof and at the other, with means for engaging and supporting a double-pointed hypodermic needle while one end of said needle is positioned in the axially extending opening and projects therethrough from the flanged end thereof, said hub element being adapted to being positioned with its flanged end portion against the resilient member and its axis substantially coincident with that of the tubular body; and a collar member of tubular metal, at one end disposed around and bent in to engage with the flanged end portion of the hub element lying against the disc-shaped member, at the other end disposed around the end of the tubular body and bent in to engage the annular grooved formation thereon, pressing these parts axially together, whereby the resilient member is held as a liquid-tight seal against the end of the tubular body; (2) a double-pointed hypodermic needle engaged with and supported on said hub element with one end thereof extending through the axial opening therein and piercing said disc-shaped resilient member; (3) piston actuating means engaged with said piston and permitting controlled axial motion of the piston in either direction at choice; and (4) a finger grip member, located near the open end of the tubular body portion of the cartridge and attached to the cartridge in a manner substantially precluding axial movement of the cartridge relative to the finger grip member.

3. A disposable hypodermic syringe comprising: (1) a cartridge that comprises an elongate tubular glass body of substantially uniform bore, open at one end, partially constricted and provided with an annular grooved formation on the outer surface near the other end thereof; a piston, positioned within the open end of the tubular body and capable of movement axially therein, engaging the inner walls thereof to provide an essentially liquid-tight closure therefor; and a partial closure at the opposite end of the tubular body, said partial closure comprising a disc-shaped member, formed of resilient, rubber-like material capable of being pierced by a needle, adapted to overlie the opening at the partially constricted end portion of the tubular body; an essentially cylindrical hub element having an opening extending axially therethrough, provided with a radially extending flanged portion at one end thereof and at the other end, with means for engaging and supporting a double-pointed hypodermic needle while one end of said needle is positioned in the axially extending opening and projects therethrough from the flanged end thereof, said hub element being adapted to being positioned with its flanged end portion against the resilient member and its axis substantially coincident with that of the tubular body; and a collar member of tubular metal, at one end disposed around and bent in to engage with the flanged end portion of the hub element lying against the disc-shaped member, at the other end disposed around the end of the tubular body and bent in to engage the annular grooved formation thereon, pressing these parts axially together, whereby the resilient member is held as a liquid-tight seal against the end of the tubular body; (2) a double-pointed hypodermic needle engaged with and supported on said hub element with one end thereof extending through the axial opening therein and piercing said disc-shaped resilient member; (3) piston actuating means engaged with said piston and permitting controlled axial motion of the piston in either direction at choice; and (4) a finger grip member, located near the open end of the tubular cartridge body and attached to the cartridge in a manner substantially precluding axial movement of the cartridge relative to the finger grip member.

4. A disposable hypodermic syringe cartridge that comprises an elongate tubular body of substantially uniform bore, open at one end, partially constricted and provided with an annular grooved formation on its outer surface near the other end thereof; a piston, positioned within the open end of the tubular body and capable of movement axially therein, engaging the inner walls thereof to provide an essentially liquid-tight closure therefor; and a partial closure at the opposite end of the tubular body, said partial closure comprising a disc-shaped member, formed of resilient material capable of being pierced readily by a needle, adapted to overlie the opening at the partially constricted end portion of the tubular body; an essentially cylindrical hub element having an opening extending axially therethrough, provided with a radially extending flanged portion at one end and, at the other end, with means for engaging with and supporting a double-pointed hypodermic needle while one end of said needle is positioned in the axially extending opening and projects therethrough from the flanged end thereof, said hub element being adapted to being positioned with its flanged end portion against the resilient member and with its axis substantially coincident with the longitudinal axis of the tubular body; and a collar member, disposed around the flanged end portion of the hub element, the resilient disc-shaped member and the tubular body end portion in engagement with the annular grooved formation thereon, pressing these parts together axially whereby the resilient member is held against the end of the tubular body to provide a liquid-tight seal therefor.

5. A disposable hypodermic syringe cartridge that comprises an elongate tubular body of substantially uniform bore, open at one end, partially constricted and provided with an annular grooved formation on its outer surface near the other end thereof; a piston, positioned within the open end of the tubular body and capable of movement axially therein, engaging the inner walls thereof to provide an essentially liquid-tight closure therefor; and a partial closure at the opposite end of the tubular body, said partial closure comprising a disc-shaped member, formed of resilient material capable of being pierced readily by a needle, adapted to overlie the opening at the partially constricted end portion of the tubular body; an essentially cylindrical hub element having an opening extending axially therethrough, provided with a radially extending flanged portion at one end and, at the other end, with means for engaging with and supporting a double-pointed hypodermic needle while one end of said needle is positioned in the axially extending opening and projects therethrough from the flanged end thereof, said hub element being adapted to being positioned with its flanged end portion against the resilient member and with its axis substantially coincident with the longitudinal axis of the tubular body; and a collar member of tubular metal, at one end disposed around and bent in to engage with the flanged end of the hub element lying against the resilient disc-shaped member, at the other end disposed around the end of the tubular body and bent in to engage the annular grooved formation thereon, pressing these parts axially together whereby the resilient member is held against the end of the tubular body to provide a liquid-tight seal therefor.

6. A disposable hypodermic syringe cartridge that comprises an elongate, tubular glass body of substantially uniform bore, open at one end, partially constricted and

provided with an annular grooved formation on its outer surface near the other end thereof; a piston, positioned within the open end of the tubular body and capable of movement axially therein, engaging the inner walls thereof to provide an essentially liquid-tight closure therefor; and a partial closure at the opposite end of the tubular body, said partial closure comprising a disc-shaped member, formed of resilient, rubber-like material capable of being pierced readily by a needle, adapted to overlie the opening at the partially constricted end portion of the tubular body; an essentially cylindrical hub element having an opening extending axially therethrough, provided with a radially extending flanged portion at one end and, at the other end, with means for engaging with and supporting a double-pointed hypodermic needle while one end of said needle is positioned in the axially extending opening and projects therethrough from the flanged end thereof, said hub element being adapted to being positioned with its flanged end portion against the resilient member and with its axis substantially coincident with the longitudinal axis of the tubular body; and a collar member of tubular metal, at one end disposed around and bent in to engage with the flanged end of the hub element lying against the resilient disc-shaped member, at the other end disposed around the end of the tubular body and bent in to engage the annular grooved formation thereon, pressing these parts axially together whereby the resilient member is held against the end of the tubular body to provide a liquid-tight seal therefor.

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