Oct. 20, 1953 C. B. GOODSTEIN ET AL 2,655,919

HYPODERMIC SYRINGE AND CARTRIDGE THEREFOR

Filed April 17, 1951

Fig. 2.

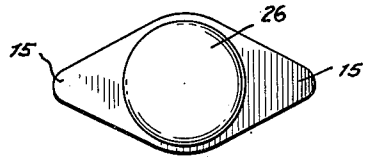


Fig. 1.

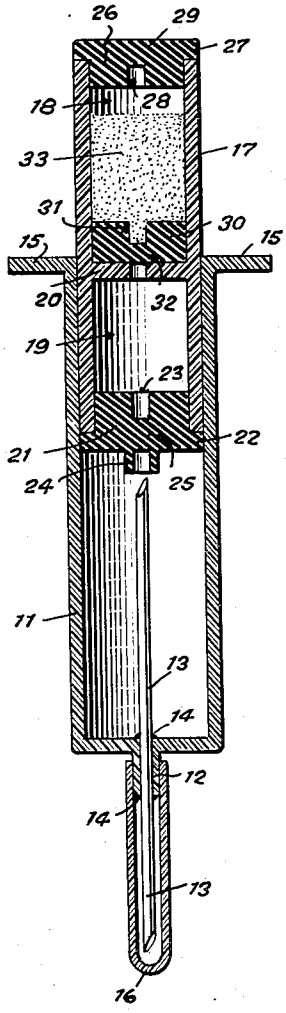


Fig. 3.

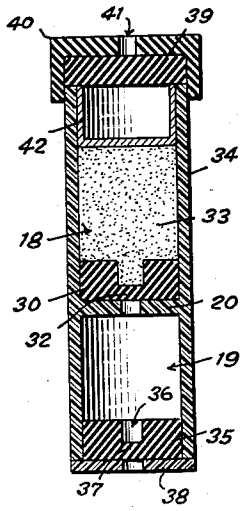
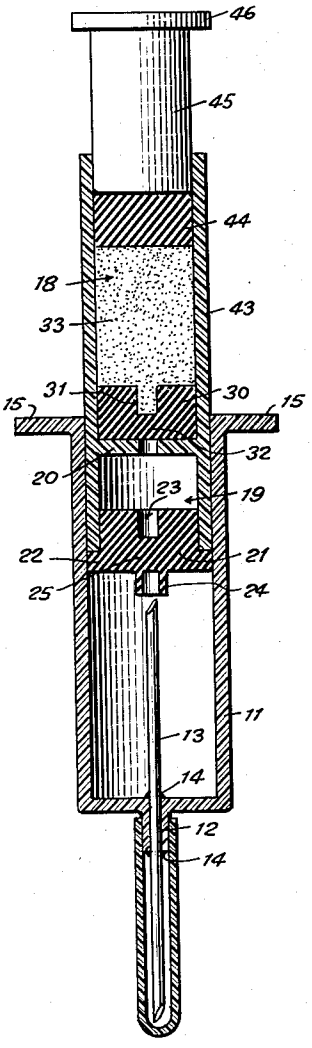


Fig. 4.



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Patented Oct. 20, 1953

2,655,919

UNITED STATES PATENT OFFICE

2,655,919

HYPODERMIC SYRINGE AND CARTRIDGE THEREFOR

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Application April 17, 1951, Serial No. 221,342

15 Claims. (Cl. 128—218)

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This invention relates to hypodermic syringes and cartridges therefor of the type employed to effect injections and more particularly to a novel unidirectional autoaspirating syringe and component cartridge.

Presently, the approved technique of making hypodermic injections may be broken down into three steps. The first step calls for the operator to insert the needle into the subject. There follows the second step of pulling back on the plunger of the conventional syringe so as to draw blood if the needle has tapped a blood vessel. If blood is so drawn, the needle must be withdrawn and steps one and two repeated. Only if no blood is drawn may the operator proceed to step three which consists of the injection of medicament.

A substantial percentage of such injections are made by technicians, i. e. persons of less training and sometimes of less willingness to observe established techniques to the letter than men and women of the medical and nursing professions. Especially is this true of the Armed Forces where it is frequently necessary to perform mass procedures or where the corpsman in the field, in an effort to administer quick rather than complete treatment, may omit step two. Hence, the Armed Forces, in particular, have long been searching for an autoaspirating syringe.

Difficulty has been experienced in the administration of step two since, usually, an operator must release the grasp of one hand upon the portion of the subject being injected in order to pull back on the plunger. A partial solution has been to provide looped finger grips, but then an inability to keep the syringe steady while aspirating has been experienced. Hence, the importance of a syringe which both aspirates and injects by means of a unidirectional stroke.

It is, therefore, a principal object of the present invention to provide a hypodermic syringe capable of first aspirating to test whether the needle has struck a blood vessel and then injecting a charge of medicament, both operations being achieved by means of a unidirectional stroke.

Another object of the present invention is to provide such a syringe which will automatically aspirate upon a partial stroke and then inject upon the completion of said stroke.

Still another object of the present invention is the provision of a cartridge, as a separate article of manufacture, of use as a component of a hypodermic syringe of either the disposable or refillable type.

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A further object of the present invention is the provision of such a cartridge which while operable unidirectionally will not only aspirate automatically, but inject automatically as well.

A still further object of the present invention is the provision of such a cartridge which when unidirectionally operated is capable of delivering two separate doses of medicament.

Another and further object of the present invention is the provision of a unidirectional autoaspirating syringe of simple construction, which may be easily and cheaply mass produced of uniform quality.

Other objects are presented and a fuller understanding of the present invention may be had by referring to the following expanded description and claims, taken in conjunction with the accompanying drawing which illustrates preferred embodiments thereof, it being understood that the foregoing statement of the objects of the invention is intended to generally explain the same without limiting it in any manner.

Fig. 1 is a longitudinal sectional view of a hypodermic syringe made in accordance with and embodying the present invention.

Fig. 2 is a top plan view thereof.

Fig. 3 is a longitudinal sectional view of a modified form of a cartridge which may be used with the barrel shown in Fig. 1.

Fig. 4 is a longitudinal sectional view of another embodiment of the present invention.

Referring to the drawing and more particularly to the embodiment of the present invention shown in Figs. 1 and 2, it includes a barrel 11 of preferably circular cross-section and fabricated of glass or a clear plastic composition, which is closed at one end except for a protruding hollow neck 12 in which neck and filling the hollow portion thereof, is rigidly mounted a hypodermic needle 13 by means of beads 14. Said needle extends axially both within and without said barrel. The open end of barrel 11 terminates in oppositely positioned normally extending flange elements which form finger grips 15. A safety cap 16, the open end of which frictionally engages the outside wall of neck 12, completes the barrel assembly.

Slideably insertable and mountable in barrel 11 without making an air seal thereto, is a tubular cartridge 17, which is divided into an upper medicament chamber 18 and a lower aspiration chamber 19 by a centrally apertured transverse partition 20. Said cartridge is preferably made of a transparent plastic composition and said transverse section may be integrally molded therein.

The lower end of aspiration chamber 19 is closed by a tightly fitting sealing plug 21, a substantially cylindrical member of puncturable rubber having a lower annular peripheral flange 22 engaging the lower end of cartridge 17 and an axially indented bore 23 on its upper surface aligned with a hollow tubular neck 24 extending from its lower surface so as to form a membrane 25 therebetween. The upper end of cartridge 17 and medicament chamber 18 is sealed by a similar tightly fitting plug 26 having an upper annular peripheral flange 27 in tight engagement with the top of said cartridge and an axially indented bore 28 extending from its lower surface to provide a membrane 29 between said bore and the upper surface of said plug. The lower end of medicament chamber 18 and the upper end of aspiration chamber 19 is closed by a cylindrical puncturable rubber plug 30 which rests on partition 20 and has an axial bore 31 partially therethrough to form membrane 32 between the bottom of said bore and the lower end of said plug. Assembly of cartridge 17 is self-evidently made by pushing plugs 21, 26 and 30 into the positions shown in the drawing in tight frictional engagement with adjoining portions of said cartridge.

To prepare cartridge 17 for use, aspiration chamber 19 is evacuated and medicament chamber 18 is given a charge of medicament and then a charge of gas under pressure. Although the method of preparing said cartridge forms no part of the subject matter of the present invention and although divers methods of evacuating and charging the chambers may be employed, in order to complete the present disclosure, one such method will be described. Medicament 33 may be poured into medicament chamber 18, to a level not reaching the level of the lower end of plug 26 when inserted, before plug 26 is placed atop cartridge 17, the other plugs being in place. Said chamber is then sealed by the placing of plug 26 thereover. The needle of a conventional hypodermic syringe, of the type consisting of a barrel in which a piston is pushed downwardly, and filled with air, is inserted through membrane 29 in plug 26 into the top of medicament chamber 18 and the contents of such syringe emptied into said chamber. This is effective to positively charge the chamber, i. e. to raise the pressure in the chamber to a level higher than atmospheric pressure. To evacuate aspiration chamber 19, the needle of such a conventional syringe, while such syringe is empty, i. e. the plunger thereof being pressed as close to the bottom of the barrel thereof as possible, is inserted through membrane 25 into said chamber. The piston is then pulled back thus sucking air from chamber 19 and effectively negatively charging said chamber, i. e., leaving it in a state where the pressure therein is less than atmospheric pressure. It is apparent that the amount of air added to medicament chamber 18 and the amount of air withdrawn from aspiration chamber 19 will depend upon the use to which the present invention is put. Also, it might be desirable from the viewpoint of some users to have an inert gas such as nitrogen instead of air in medicament chamber 18.

In using the syringe, the operator first disengages safety cap 16 so as to bare needle 13. The needle is then introduced into the tissues of a subject in conventional fashion. Pressing down on the top of cartridge 17, the operator causes the bottom of said cartridge to press against the top of needle 13 and upon the exertion of greater

pressure causes needle 13 to pierce membrane 25 in plug 21. As soon as the opening in the top of said needle clears said membrane and enters aspiration chamber 19, a sucking action takes place by reason of the low pressure in said chamber. If said needle taps a blood vessel, blood will be drawn into the aspiration chamber and the operator will withdraw the needle and may then repeat the insertion process with a new syringe. If the lower end of needle 13 is resting in muscle or other tissue and not in an artery or vein, no blood will be drawn into said aspiration chamber. Noting this, the operator then proceeds to the injection phase of the operation merely by continuing to push downwardly on the top of cartridge 17. This causes the top of needle 13 to pass through the aperture in partition 20 and through membrane 32 in plug 30. Upon completing its passage through said plug, it enters medicament chamber 18, at which point, the medicament under pressure from the gas above it enters the needle and is pushed into the subject's tissues.

The interval necessary between the commencement of aspiration and the commencement of injection will depend to a great extent upon the degree of expertness of the operator. With experience an operator may complete both steps with no interruption of an even downward pressure on cartridge 17, if no blood is drawn during aspiration. In this fashion, by unidirectional travel of cartridge 17 relative to the barrel assembly, the syringe sequentially aspirates and injects.

In employing the syringe shown in Figs. 1 and 2 and described above, the operator must be careful to keep it in a vertical position while injecting, else air may enter the needle, be injected into the subject and cause a painful and sometimes dangerous result. The cartridge shown in Fig. 3 obviates the need for such care. Here the tubular cartridge 34 is fashioned similarly to cartridge 17 (see Fig. 1), being intermediately transversely divided by partition 20 into lower aspiration chamber 19 and upper medicament chamber 18 with sealing plug 30 respectively closing the bottom and top of said chambers. However, instead of plug 21, a more simply made plug 35 seals the bottom of aspiration chamber 19, said plug having an axial bore 36 extending from its upper surface to form membrane 37 between the bottom of said bore and the bottom of said plug. Beneath plug 35 is circular apertured section 38 preferably of plastic lies over the lower end of cartridge 34 and forms the bottom thereof. Said section adds structural strength to the cartridge and the aperture therein acts as a guide for the entry of needle 13. Medicament chamber 18 is closed by a solid sealing plug 39 retained in place by a plastic or metallic cap 40 which may be friction fitted, as shown, or made to possess threads corresponding to mating threads then formed along the upper walls of cartridge 34. Said cap 40 has an axially located aperture 41, the function of which will be presently explained. The most important element of difference between cartridges 17 and 34 lies in the addition to the latter of a preferably cylindrical piston member 42, open at the top and closed at the bottom, which is slideably mounted in medicament chamber 18 and normally rests on the charge of medicament therein. It is snugly seated within the side walls of said chamber and may be coated with a lubricant so as to be freely slideably there-

in while airtightly isolated from the remainder of said chamber.

Cartridge **34** is assembled in a manner similar to that employed in assembling cartridge **17**, with the addition, of course, of section **38**, preferably fixed in place by an adhesive after plug **35** has been inserted and the insertion of piston member **42** after medicament **33** has been poured into medicament chamber **18**. It is then prepared similarly except that in positively charging said medicament chamber, gas under pressure is introduced by a needle which passes through aperture **41** in cap **40** and plug **39**. The gas enters piston member **42** and does not come into contact with either medicament **33** or needle **13** at any time. In order to insure that medicament **33** be prevented from creeping between the outside wall of piston member **42** and the inside wall of medicament chamber **18** adjacent thereto and that gas not be displaced into the portion of said chamber occupied by said medicament, it is desirable that the top surface of said piston member and the lower surface of plug **39** be in sealed relationship. To accomplish this despite the slight variances in the level of medicament **33** from filling to filling, and the consequent varying relative heights of the top surfaces of cartridge **34** and piston member **42**, it is preferred that sealing plug **39** be quite yieldable so as to be readily forced upon said top surface of said piston member and retained in such position by cap **40**.

In operation cartridge **34** performs in precisely the same fashion as does cartridge **17** except that when needle **13** enters medicament chamber **18**, the contents are pressed into and out of the needle by piston **42** which in turn is actuated by the pressure of the gas between it and plug **39**. In this embodiment, the syringe may be safely tipped while injecting since no air may reach the upper end of needle **13**.

The forms of the present invention previously described have been each adapted to automatic injection as well as autoaspiration. However, there are applications for which manual injection, i. e. where the operator, instead of a column of gas under pressure, forces out the medicament, is preferable or even necessary. Fig. 4 illustrates a syringe adapted for manual injection. The barrel assembly is identical with that shown in Fig. 1. The cartridge **43** of this embodiment is the same, as well, except that plug **26** of the first form is replaced by a slideably mounted piston plug **44** set within the upper walls of cartridge **43** and a plunger rod **45** surmounted by a head **46** is slideably positioned over said plug. Plug **44** is preferably similar to all of the other plugs employed in the various forms described, which are made of a material, preferably rubber, puncturably by a hypodermic needle, compressible, so that they may be inserted within the cartridge employed to make airtight and liquid-tight seals with the walls of such cartridge and self-sealing so that if a needle is inserted in, passed through or removed from such plugs, neither gas or liquid will pass therethrough. When in the claims mention is made of self-sealing, or self-sealing and pierceable walls, reference is made to such plugs. For obvious reasons, plug **44** need not be pierceable. Although not so shown, the side walls of piston plug **44** may be laterally grooved to facilitate axial displacement within cartridge **43** and to improve the seal. Assembly and preparation are self-evident from the material included above. In employing this form the operator inserts needle **13** into the tissues of a subject and

then presses downwardly upon head **46** of plunger **45**. The liquid medicament being incompressible and the operator maintaining barrel **11** steady, such pressure results in a downward movement of cartridge **43** causing needle **13** to pierce membrane **25** in plug **21** producing aspiration. Upon the exertion of further pressure membrane **32** in plug **30** is pierced at which point an outlet for medicament **33**, under pressure transmitted through piston plug **44**, is provided by needle **13**. Said plug starts to move downwardly and pushes the contents of chamber **43** through said needle. Here again aspiration and injection are produced by a unidirectional displacement of the cartridge. In this instance, however, injection is induced by manual pressure rather than by a previously prepared positive charge.

It is to be emphasized that the subject invention may be employed with throw-away syringes, or with syringes wherein the barrel assembly is kept, while cartridges are discarded after one use, and additional cartridges are used for refilling purposes, or with permanently retained syringes wherein both barrel assemblies and cartridges are used and reused. The ease with which cartridges are refilled and charged, as exemplified in the method of preparation described above, facilitates this last manner of employment. On the other hand, since the simple construction disclosed enables manufacture at low cost, single-use syringes may be economically used.

Then, too, if aspiration is not desired, the forms shown may easily be employed to deliver two discrete charges of medicament. In such event only the procedure of filling and charging need be changed. For example, the syringe illustrated in Figs. 1 and 2 might be so used if both chambers were loaded with medicament and air under pressure introduced. The same is true of the form illustrated in Fig. 3. The form of Fig. 4 could be so employed if the lower chamber **19** were given the positive charge along with a filling of medicament while the remainder of the syringe remains as shown.

Although the subject invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous additional changes in the details of construction, combination and arrangement may be resorted to without transcending the scope of the invention as hereinafter claimed.

What is claimed is:

1. A hypodermic syringe including a cup-shaped barrel provided with an aperture in its bottom wall, a hypodermic needle mounted to said barrel through said aperture having ends projecting inwardly and outwardly of said barrel, and means defining first and second axially aligned closed chambers slideably disposed in said barrel, said first chamber being at least partially evacuated, said first chamber being of a predetermined substantially fixed capacity having end walls which are self-sealing and pierceable by said needle and one of which walls confronts said needle and said second chamber having the wall confronting the top of said first chamber likewise self-sealing and pierceable so as to permit sequential entry of the inwardly projecting end of said needle into said chambers as said chambers are pressed toward the bottom wall of said barrel.

2. A hypodermic syringe as described in claim 1, said second chamber containing a charge of medicament and means, comprising gas under

pressure within said second chamber, to expel said medicament through said needle upon entry of said inwardly projecting end thereof into said chamber.

3. A hypodermic syringe as described in claim 1, said second chamber containing a charge of medicament and means, to expel said medicament through said needle upon entry of said inwardly projecting end thereof into said second chamber, comprising a piston member arranged to slide longitudinally in said second chamber in sealing relation with the interior thereof, said charge of medicament being contained between said piston member and the end wall of said second chamber confronting said first chamber, and a charge of compressed gas confined between said piston member and the remaining end of said chamber whereby when said inwardly projecting end of said needle enters said chamber, said compressed gas charge will operate to move said piston member against said charge of medicament so as to expel the same through said needle.

4. A hypodermic syringe as described in claim 1, said second chamber containing a charge of medicament, and means, to expel said medicament through said needle upon entry of said inwardly projecting end thereof into said chamber, comprising a piston plug closing the end of said second chamber remote from said first chamber, said plug being in sealing relation with the side walls of said chamber and mounted for longitudinal travel therein, and means to enable the manual driving of said piston plug against said medicament so that when said needle enters said second chamber, said plug may be caused to move longitudinally within said chamber to expel said charge of medicament through said needle.

5. A hypodermic syringe including a cup-shaped barrel provided with an aperture in its bottom wall, a hypodermic needle mounted to said barrel through said aperture having ends projecting inwardly and outwardly of said barrel, and means defining first and second axially aligned closed chambers slideably disposed in said barrel, said first chamber, being of a predetermined substantially fixed capacity, having end walls which are self-sealing and pierceable by said needle and one of which walls confronts said needle and said second chamber having the wall confronting the top of said first chamber likewise self-sealing and pierceable so as to permit sequential entry of the inwardly projecting end of said needle into said chambers as said chambers are pressed toward the bottom wall of said barrel, said first chamber being at least partially evacuated and said second chamber containing a charge of medicament, and means to expel said medicament through said needle upon entry of said inwardly projecting end thereof into said chamber.

6. A hypodermic syringe as described in claim 5, said means to expel said medicament comprising gas under pressure within said chamber.

7. A hypodermic syringe as described in claim 5, said means to expel said medicament comprising a piston plug closing the end of said second chamber remote from said first chamber, said plug being in sealing relation with the side walls of said chamber and mounted for longitudinal travel therein, and means to enable the manual driving of said piston plug against said medicament so that when said needle enters said second chamber said plug may be caused to move longitudinally within said chamber and to expel said charge of medicament through said needle.

8. A hypodermic syringe including a cup-shaped barrel member provided with an aperture in its bottom wall, a hypodermic needle mounted to said barrel through said aperture having ends projecting inwardly and outwardly of said barrel, and a tubular cartridge slideably mounted in said barrel, said cartridge being provided with top and bottom walls and a wall intermediate said walls so as to provide axially disposed closed chambers within said cartridge, said chamber defined by said bottom and intermediate walls being at least partially evacuated, said bottom and intermediate walls defining a chamber of a predetermined substantially fixed capacity, and being self-sealing and pierceable by said needle so as to permit sequential entry of the inwardly projecting end of said needle into said chambers as said cartridge is pressed toward the bottom wall of said barrel.

9. A hypodermic syringe as described in claim 8, said chamber defined by said top and intermediate walls containing a charge of medicament and means, comprising gas under pressure within said chamber, to expel said medicament through said needle upon the entry of said inwardly projecting end thereof into said chamber.

10. A hypodermic syringe as described in claim 8, said chamber defined by said top and intermediate walls containing a charge of medicament and means, to expel said medicament through said needle upon the entry of said inwardly projecting end thereof into said chamber, comprising a piston member arranged to slide longitudinally in said chamber defined by said top and intermediate walls in sealing relation with the interior thereof, said charge of medicament being contained between said piston member and the end wall of said chamber confronting the chamber defined by said bottom and intermediate walls, and a charge of compressed gas confined on the other side of said piston member pressing said member against said medicament, whereby when said inwardly projecting end of said needle enters said chamber through said intermediate wall, said charge of compressed gas will operate to move said piston member against said charge of medicament so as to expel the same through said needle.

11. A hypodermic syringe including a cup-shaped barrel member provided with an aperture in its bottom wall, a hypodermic needle mounted to said barrel through said aperture having ends projecting inwardly and outwardly of said barrel, and a tubular cartridge slideably mounted in said barrel, said cartridge being provided with top and bottom walls and a wall intermediate said walls so as to provide axially disposed closed chambers within said cartridge, said bottom and intermediate walls being self-sealing and pierceable by said needle so as to permit sequential entry of the inwardly projecting end of said needle into said chambers as said cartridge is pressed toward the bottom wall of said barrel, said chamber defined by said bottom and intermediate walls being at least partially evacuated, and being of a predetermined substantially fixed capacity, and said chamber defined by said top and intermediate walls containing a charge of medicament, and means to expel said medicament through said needle upon the entry of said inwardly projecting end thereof into said chamber.

12. A cartridge for use with a hypodermic

holder and needle comprising a tubular member having end walls and a transverse intermediate wall dividing said member into an aspiration chamber and a medicament chamber, said end walls of said aspiration chamber, and at least the end wall of said medicament chamber confronting said aspiration chamber, being self-sealing and pierceable walls, said aspiration chamber being at least partially evacuated, and being of a predetermined substantially fixed capacity, said medicament chamber containing a charge of medicament, and means to expel said medicament through a hypodermic needle from said medicament chamber upon the entry therein of said needle.

13. A cartridge as described in claim 12, said means to expel said medicament comprising gas under pressure within said medicament chamber.

14. A cartridge as described in claim 12, said means to expel said medicament comprising a piston member arranged to slide longitudinally in said medicament chamber in sealing relation with the interior thereof, said charge of medicament being contained between said piston member and the end wall of said medicament chamber confronting said aspiration chamber, and a charge of compressed gas between said piston member and the other end of said medicament chamber.

15. A cartridge as described in claim 12, said means to expel said medicament comprising a piston plug forming the end wall of said medicament chamber remote from said aspiration chamber, said plug being in sealing relation with

the side walls of said medicament chamber and mounted for longitudinal travel therein, and means to enable the manual driving of said piston plug against said medicament so that when said needle enters said medicament chamber, said plug is caused to move longitudinally within said chamber and to expel said charge of medicament through said needle.

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