July 20, 1954 S. R. ORENS 2,684,068

SYRINGE

Filed Feb. 21, 1951

FIG. 1

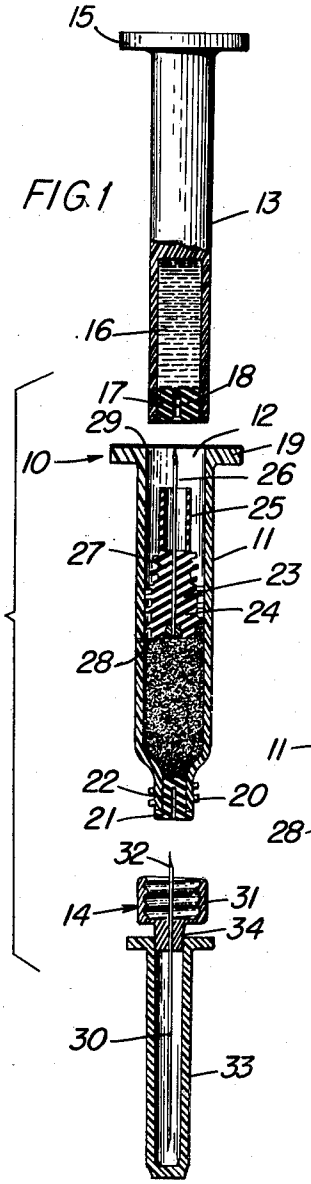


FIG. 3

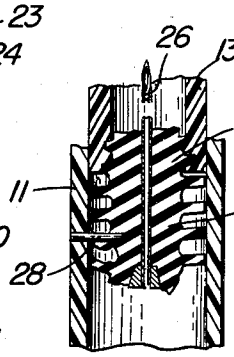
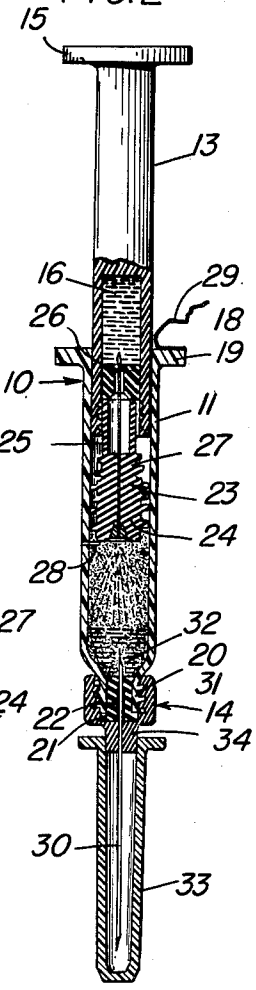


FIG. 2



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UNITED STATES PATENT OFFICE

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SYRINGE

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Application February 21, 1951, Serial No. 212,096

9 Claims. (Cl. 128—220)

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This invention relates to a syringe, and more particularly a syringe, wherein one part of the charge to be injected thereby is initially contained in one element of the syringe and another part of the charge is initially contained in a separate element of the syringe. The invention is especially useful in its application to a disposable hypodermic syringe wherein the medicament and the solvent therefor are separately contained in separate parts of the syringe, to which use, however, the invention is not restricted.

As is well known, many compounds, mixtures, or solutions deteriorate with time or under varying conditions of temperature, light or other changing surroundings. For example, an aqueous solution of penicillin cannot be kept for long without excessive deterioration. Mixing such compounds, mixtures or solutions at the point of use involves many inconveniences, as the necessity for numerous containers, accurate measurement under disadvantageous conditions, time requirements, breakage hazards and the like. Such disadvantages are particularly marked under emergency conditions like those encountered on the battlefield, at advance hospitals, at disaster first aid centers and the like.

Attempts have heretofore been made to solve this problem, so far as it relates to hypodermic syringes, by means of compartmented syringe bodies or by positioning capsules in unitary syringe barrels, the separating walls being broken, displaced or pierced immediately before use of the syringe. However, such arrangements have not been wholly satisfactory.

I have now found that it is possible to construct a syringe in two separate parts which may be brought together to function as a unitary apparatus. The two components of the compound, mixture or solution, each in measured quantity, are separately placed in the separate parts of the syringe, which may be separately stored under optimum conditions until the time of use. Then the parts of the syringe are very simply combined, and mixture of the resulting fluid is effected by exceedingly simple operation of the apparatus.

According to the invention, there is provided a syringe barrel having an open rear end and a separate plunger insertable into the rear end of the syringe barrel. The plunger is formed to contain one component of the compound, mixture or solution to be injected by the syringe, which is sealed therein. The other component is sealed within the separate syringe barrel. Specially-formed elements are disposed in the syringe barrel whereby, upon insertion of the plunger into the rear end of the barrel and upon simple manipulation of the plunger, the two components are mixed and the resulting fluid is discharged from the syringe barrel from its opposite end.

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The invention is shown by way of illustration in its application to a disposable hypodermic syringe in the accompanying drawings, in which—

Fig. 1 is a longitudinal mid-section through a hypodermic syringe constructed in accordance with the invention, the principal parts being shown separated from one another, and the plunger being shown partly in elevation;

Fig. 2 is a similar sectional view of the syringe illustrated in Fig. 1, the principal parts being shown in assembled position; and

Fig. 3 is an enlarged fragmental section showing the resilient stopper in engagement with the plunger at the beginning of the hypodermic injection stroke.

In the embodiment of the invention which is illustrated in the drawings, there is shown a hypodermic syringe 10 comprising a barrel 11 having an open rear end 12, and a plunger 13 insertable into the open rear end 12 of the barrel 11. A hypodermic needle assembly 14 is detachably fixed to the forward end of the barrel 11 in a manner later to be described.

The plunger 13 here shown is formed of inexpensive plastic and is cylindrical, having a diameter which enables it to enter the barrel 11 and to be reciprocated easily therein. An outer terminal flange 15 provides simple and effective means whereby the plunger may be pushed into and pulled out of the barrel 11. The plunger is entirely separate from the barrel until it is inserted therein, and may be separately packed, transported and stored as a unit or as one of a group of units.

The plunger 13 is formed with a cavity or chamber 16 at its forward end, that is to say its end which enters the open rear end 12 of the barrel 11. The cavity or chamber 16 in the plunger is given a size which exactly measures the required volume of one component of the compound, mixture or solution to be injected by the syringe, and is internally threaded at its forward end. As here shown the chamber 16 is filled with a liquid solvent.

The cavity or chamber 16 is closed by a sealing diaphragm extending transversely thereof and slidable axially therein. As here shown the seal-

ing diaphragm is formed by a rubber plug 17, having therein a central cavity 18 for entrance of a piercing needle in a manner later to be described. Thus, with the cavity or chamber 16 suitably filled and the sealing diaphragm or rubber plug in place, one component of the charge to be injected by the syringe is separately contained in the separate plunger 13.

The barrel 11 which is illustrated in the drawings is also formed of inexpensive plastic in order that the entire syringe may be discarded after use. The barrel is cylindrical in form with a circumferential flange 19 surrounding its open rear and 12 to facilitate manipulation of the syringe. At the forward end of the barrel 11 there is formed an externally threaded nipple 20 for reception of the hypodermic needle assembly 14. Thus, forward movement of the plunger 13 in the barrel 11 forces the contents of the barrel outwardly through the nipple 20 for injection.

The externally threaded nipple 20 is closed by a resilient flanged plug 21 shown as a rubber plug and having therein a central cavity 22 for entrance of the sharpened rear end of the hypodermic needle of the needle assembly 14 in a manner later to be described. The resilient flanged plug is of sufficient size to seal the barrel 11 upon insertion into the externally threaded nipple 20 and to remain in place during packing, transportation and storage of the barrel as a separate unit.

The second component of the compound, mixture or solution to be injected by the syringe is contained in the barrel 11, and is here illustrated as a powder which may be powdered penicillin. This component, in carefully measured quantity, is retained in the barrel between the resilient flanged plug 21 and a stopper 23 which is slidable axially in the barrel and which seals the contents therein. The stopper 23 is preferably made of rubber and comprises a transverse contact portion 24 resiliently engaging the walls of the barrel, a stem portion 25 fixed to the contact portion and projecting axially rearwardly thereof, and a hollow needle 26 sharpened at its rear end and extending axially through the contact portion 24 and the stem portion 25 and fixed therein. Between the contact portion and the stem portion of the stopper 23 there is provided a coned threaded portion 27 for a purpose which will later appear. As here shown the contact portion is somewhat elongated and has, extending radially therefrom, a series of projections which are in resilient contact with the inner walls of the barrel. The stopper 23 is therefore formed of a material which enables it to be easily torn through its projections.

A pin 28 is fixed in one wall of the barrel 11 and extends radially inwardly from the wall to limit the extent to which the stopper 23 may be moved into the barrel 11 in the absence of sufficient pressure to force it past the pin. When, however, the necessary force is applied to the stopper 23 it may be moved past the pin 28, which tears through the outwardly extending flanges of the stopper. As the stopper passes the pin 28 the resiliency of the material of which the stopper is formed causes the torn portions of the stopper to close ahead of the pin, thereby maintaining the sealing effect of the stopper within the barrel.

Because the stopper does not seal the contents of the barrel absolutely, owing to the fact that the needle 26 is hollow, it is preferred to close the open rear end of the barrel 11 by means of a sheet of thin plastic material 29. The sheet 29 is preferably sealed to the circumferential flange 19 by means of an adhesive, although other means for seatling the sheet 29 across the open rear end of the barrel may be employed.

The hypodermic needle assembly 14 comprises a hypodermic needle 30 fixed in an internally threaded bushing 31 of a size to screw upon the threads of the externally threaded nipple 20. The hypodermic needle 30 extends forwardly of the internally threaded bushing for a convenient distance having the usual sharpened end. The needle 30 also extends rearwardly through the internally threaded bushing to terminate in a sharpened end 32 beyond the bushing. A plastic shield 33 fits frictionally over a forwardly extending cylindrical boss 34 on the internally threaded bushing 31 and guards the hypodermic needle 30 when not in use.

From the foregoing, operation of the hypodermic syringe will be easily understood. When the syringe is to be used, the sheet of thin plastic material is removed from the circumferential flange 19 and the plunger 13 is inserted in the open rear end 12 of the barrel 11. Thereupon the sharpened rear end of the hollow needle 26 enters the central cavity 18 in the sealing diaphragm or rubber plug 17 and pierces the thin section thereof at the inner end of the cavity. Thus the contents of the cavity or chamber 16 in the plunger 13 is connected with the contents of the barrel 11 beyond the stopper 23.

By pushing the plunger 13 forwardly into the barrel, the rubber plug 17 is brought into contact with the stem portion 25 of the stopper 23, and forward motion of the plunger 13 in the same direction moves the rubber plug 17 inwardly of the cavity 16 to force the contents of the cavity through the hollow needle 26 and into the barrel ahead of the stopper 23. See Fig. 2. Continued movement of the plunger 13 causes the internal threads of the cavity 16 to engage the coned threaded portion of the stopper 23. Thereupon a quarter turn of the plunger 13 causes the plunger to engage the stopper so that the plunger and the stopper may thereafter be reciprocated unitarily within the barrel 11.

The rubber plug having now been forced to the end of the cavity 16, all of the solvent in the cavity has been forced into the barrel 11. The assembled syringe is now shaken. Thus the powder initially contained in the barrel may be fully dissolved in the solvent initially contained in the plunger.

The hypodermic needle assembly 14 is next connected to the forward end of the barrel 11 by screwing the internally threaded bushing 31 upon the externally threaded nipple 20. This operation causes the sharpened end 32 of the hypodermic needle 30 to enter the cavity 22 in the plug 21, piercing the plug beyond the cavity to enter the barrel 11. The plastic shield 33 is now removed from the hypodermic needle assembly and the apparatus is ready for use.

Because the stopper and the plunger are now fully engaged it is possible to insert the hypodermic needle 30 in the usual manner and to withdraw the plunger slightly to "aspirate" through the hypodermic needle and to observe whether or not blood is drawn.

The injection is now made simply by moving the plunger 13 into the barrel 18 for a sufficient distance to inject the entire contents of the barrel through the hypodermic needle 30. During this operation the pin 28 tears through the stopper

which immediately closes again ahead of the pin and maintains the seal. See Fig. 3.

Because of the inexpensive materials of which the various parts of the syringe are formed, the used syringe may be discarded. This is of particular value in military and emergency situations.

Accordingly, it will be obvious that the present invention provides a syringe in two separate parts which may be brought together to function as a unitary apparatus. Before use the two components of the compound, mixture or solution, each in measured quantity, may be separately packed, transported and stored under optimum conditions. The apparatus is inexpensive, simple and easily operated with a minimum of skill.

The form of the invention here described and illustrated is presented merely as an indication of how the invention may be applied. Other forms, embodiments and applications of the invention coming within the proper scope of the appended claims, will, of course, readily suggest themselves to those skilled in the art.

I claim:

1. A syringe comprising: a barrel for containing one component of the charge to be injected by the syringe, said barrel having an open rear end; a separate plunger insertable into the rear end of said barrel, said plunger being formed with a cavity at its forward end for containing a second component of the charge to be injected by the syringe; and a diaphragm extending transversely of the cavity in said plunger for sealing the component of the charge therein, said diaphragm being slidable axially therein; in combination with a stopper slidable axially in said barrel for sealing the component of the charge therein, said stopper having a rearwardly extending stem thereon for contact with said diaphragm to force it rearwardly in said plunger; and a hollow needle extending through said stopper beyond the stem thereon and having a sharpened rear end for piercing said diaphragm; whereby insertion of said plunger into the rear end of said barrel and forward movement of said plunger in said barrel causes said needle to pierce said diaphragm and the stem on said stopper to move said diaphragm rearwardly of the cavity in said plunger to discharge the component of the charge contained in said plunger therefrom into said barrel ahead of said stopper for mixture with the component of the charge in said barrel.

2. A syringe comprising: a barrel for containing one component of the charge to be injected by the syringe, said barrel having an open rear end; a separate plunger insertable into the rear end of said barrel, said plunger being formed with a cavity at its forward end for containing a second component of the charge to be injected by the syringe; and a diaphragm extending transversely of the cavity in said plunger for sealing the component of the charge therein, said diaphragm being slidable axially therein; in combination with a stopper of easily torn resilient material slidable axially in said barrel for sealing the component of the charge therein, said stopper having a rearwardly-extending stem thereon for contact with said diaphragm to force it rearwardly in said plunger; a hollow needle extending through said stopper through and beyond the stem thereon and having a sharpened rear end for piercing said diaphragm; and a pin extending radially inwardly from a wall of said barrel for restraining movement of said stopper forwardly of said barrel; whereby insertion of said plunger into the rear end of said barrel and forward movement of said plunger in said barrel causes said needle to pierce said diaphragm and the stem on said stopper to move said diaphragm rearwardly of the cavity in said plunger to discharge the component of the charge contained in said plunger therefrom into said barrel ahead of said stopper for mixture with the component of the charge in said barrel, and whereby further forward movement of said plunger in said barrel forces said stopper past said pin to discharge the mixed components in said barrel therefrom.

3. A syringe comprising: a barrel for containing one component of the charge to be injected by the syringe, said barrel having an open rear end; a separate plunger insertable into the rear end of said barrel and axially reciprocable therein, said plunger being formed with a chamber open at the end thereof which enters the rear end of said barrel for containing a second component of the charge to be injected by the syringe; and a diaphragm closing the chamber in said plunger to seal the component of the charge therein and resiliently engaging the walls thereof for axial movement therein; in combination with a stopper slidable axially within said barrel and sealing the interior portion of said barrel on one side of said stopper from that on its opposite side to confine in said barrel the component of the charge to be injected by the syringe, said stopper comprising a transverse contact portion resiliently engaging the walls of said barrel, a stem portion fixed to said contact portion and projecting axially rearwardly thereof toward the open rear end of said barrel, and a hollow needle extending axially through said contact portion and said stem portion fixed therein and terminating in a sharpened end beyond said stem portion; whereby insertion of said plunger into said barrel causes the sharpened end of said hollow needle to pierce said diaphragm, and further insertion of said plunger into said barrel causes said stem portion to move said diaphragm rearwardly within the chamber in said plunger to force the component of the charge contained in said plunger through said needle and into the forward part of said barrel, and whereby still further insertion of said plunger into said barrel moves said stopper forwardly in said barrel to expel from said barrel the combined components of the charge ahead of said stopper.

4. A syringe comprising: a barrel having an open rear end; a separate plunger insertable into the rear end of said barrel and axially reciprocable therein, said plunger being formed with a chamber open at the end thereof which enters the rear end of said barrel; and a diaphragm closing the chamber in said plunger to seal therein one component of the charge to be injected by the syringe and resiliently engaging the walls thereof for axial movement therein; in combination with a stopper slidable axially within said barrel and sealing the interior portion of said barrel on one side of said stopper from that on its opposite side to seal in said barrel a second component of the charge to be injected by the syringe, said stopper comprising a transverse contact portion of easily torn resilient material engaging the walls of said barrel, a stem portion fixed to said contact portion and projecting axially rearwardly thereof toward the open rear end of said barrel, and a hollow needle extending axially through said contact portion

and said stem portion fixed therein and terminating in a sharpened end beyond said stem portion; and a pin extending radially inwardly from a wall of said barrel for restraining movement of said stopper forwardly of said barrel; whereby insertion of said plunger into said barrel causes the sharpened end of said hollow needle to pierce said diaphragm, and further insertion of said plunger into said barrel causes said stem portion to move said diaphragm rearwardly within the chamber in said plunger to force the component contained therein through said needle and into the forward part of said barrel to mix with the component of the charge contained therein, and whereby still further insertion of said plunger into said barrel forces said stopper past said pin tearing its contact portion and moves said stopper forwardly in said barrel to expel from said barrel the mixed components of the charge ahead of said stopper.

5. A syringe comprising: a barrel having an open rear end; a separate plunger insertable into the rear end of said barrel and axially reciprocable therein, said plunger being formed with a chamber open at the end thereof which enters the rear end of said barrel for containing one component of the charge to be injected by the syringe, said plunger being internally threaded at the forward end of the chamber therein; and a diaphragm closing the chamber in said plunger to seal therein the component of the charge, said plunger resiliently engaging the walls thereof for axial movement therein; in combination with a stopper slidable axially within said barrel and sealing the interior portion of said barrel on one side of said stopper from that on its opposite side to seal in said barrel a second component of the charge to be injected by the syringe, said stopper comprising a transverse contact portion resiliently engaging the walls of said barrel, a stem portion fixed to said contact portion and projecting axially rearwardly thereof toward the open rear end of said barrel, and a hollow needle extending axially through said contact portion and said stem portion fixed therein and terminating in a sharpened end beyond said stem portion, said stopper being externally threaded to engage the internal threads of said plunger and make possible movement of said stopper by said plunger in either direction within said barrel; whereby insertion of said plunger into said barrel causes the sharpened end of said hollow needle to pierce said diaphragm, and further insertion of said plunger into said barrel causes said stem portion to move said diaphragm rearwardly within the chamber in said plunger to force the component contained therein through said needle and into the forward part of said barrel to mix with the component of the charge contained therein, and whereby still further insertion of said plunger into said barrel moves said stopper forwardly in said barrel to expel from said barrel the mixed components of the charge ahead of said stopper.

6. A syringe comprising: a barrel having an open rear end; a separate plunger insertable into the rear end of said barrel and axially reciprocable therein, said plunger being formed with a chamber open at the end thereof which enters the rear end of said barrel for containing one component of the charge to be injected by the syringe, said plunger being internally threaded at the forward end of the chamber therein; and a diaphragm closing the chamber in said plunger to seal therein the component of the charge, said plunger resiliently engaging the walls thereof for axial movement therein; in combination with a stopper slidable axially within said barrel and sealing the interior portion of said barrel on one side of said stopper from that on its opposite side to seal in said barrel a second component of the charge to be injected by the syringe, said stopper comprising a transverse contact portion of easily torn resilient material engaging the walls of said barrel, a stem portion fixed to said contact portion and projecting axially rearwardly thereof toward the open rear end of said barrel, and a hollow needle extending axially through said contact portion and said stem portion fixed therein and terminating in a sharpened end beyond said stem portion, said stopper being externally threaded to engage the internal threads of said plunger and make possible movement of said stopper by said plunger in either direction within said barrel; and a pin extending radially inwardly from a wall of said barrel for restraining movement of said stopper forwardly of said barrel; whereby insertion of said plunger into said barrel causes the sharpened end of said hollow needle to pierce said diaphragm, and further insertion of said plunger into said barrel causes said stem portion to move said diaphragm rearwardly within the chamber in said plunger to force the component contained therein through said needle and into the forward part of said barrel to mix with the component of the charge contained therein, and whereby still further insertion of said plunger into said barrel forces said stopper past said pin tearing its contact portion and moves said stopper forwardly in said barrel to expel from said barrel the mixed components of the charge ahead of said stopper.

7. A hypodermic syringe comprising: a barrel formed with an open rear end and an externally-threaded nipple at its forward end; a resilient flanged plug having a flange diameter substantially equal to the external diameter of the nipple on said barrel inserted externally into the nipple on said barrel to seal its forward end, said plug being pierceable by the rear end of a hypodermic needle assembly screwed upon said nipple; a separate plunger insertable into the rear end of said barrel and axially reciprocable therein, said plunger being formed with a chamber open at the end thereof which enters the rear end of said barrel for containing one component of the charge to be injected by the syringe; and a diaphragm closing the chamber in said plunger to seal therein the component of the charge, said plunger resiliently engaging the walls thereof for axial movement therein; in combination with a stopper slidable axially within said barrel and sealing the interior portion of said barrel on one side of said stopper from that on its opposite side to seal in said barrel a second component of the charge to be injected by the syringe, said stopper comprising a transverse contact portion resiliently engaging the walls of said barrel, a stem portion fixed to said contact portion and projecting axially rearwardly thereof toward the open rear end of said barrel, and a hollow needle extending axially through said contact portion and said stem portion fixed therein and terminating in a sharpened end beyond said stem portion; whereby insertion of said plunger into said barrel causes the sharpened end of said hollow needle to pierce said diaphragm and further insertion of said plunger into said barrel causes said stem portion to move said diaphragm rearwardly within the chamber in said plunger to force the component contained therein through

said needle and into the forward part of said barrel to mix with the component of the charge contained therein, and whereby still further insertion of said plunger into said barrel moves said stopper forwardly in said barrel to expel from said barrel the mixed components of the charge ahead of said stopper through the nipple thereon and a hypodermic needle assembly screwed upon the nipple.

8. A hypodermic syringe comprising: a barrel formed with an open rear end and an externally-threaded nipple of reduced diameter formed at its forward end; a resilient flanged plug having a flange diameter substantially equal to the external diameter of the nipple on said barrel inserted externally into the nipple on said barrel to seal its forward end, said plug being pierceable by the rear end of a hypodermic needle assembly screwed upon said nipple; a separate plunger insertable into the rear end of said barrel and axially reciprocable therein, said plunger being formed with a chamber open at the end thereof which enters the rear end of said barrel for containing one component of the charge to be injected by the syringe, said plunger being internally threaded at the forward end of the chamber therein; and a diaphragm closing the chamber in said plunger to seal therein the component of the charge, said plunger resiliently engaging the walls thereof for axial movement therein; in combination with a stopper slidable axially within said barrel and sealing the interior portion of said barrel on one side of said stopper from that on its opposite side to seal in said barrel a second component of the charge to be injected by the syringe, said stopper comprising a transverse contact portion of easily torn resilient material engaging the walls of said barrel, a stem portion fixed to said contact portion and projecting axially rearwardly thereof toward the open rear end of said barrel, and a hollow needle extending axially through said contact portion and said stem portion fixed therein and terminating in a sharpened end beyond said stem portion, said stopper being externally threaded to engage the internal threads of said plunger and make possible movement of said stopper by said plunger in either direction within said barrel; and a pin extending radially inwardly from a wall of said barrel for restraining movement of said stopper forwardly of said barrel; whereby insertion of said plunger into said barrel causes the sharpened end of said hollow needle to pierce said diaphragm, and further insertion of said plunger into said barrel causes said stem portion to move said diaphragm rearwardly within the chamber in said plunger to force the component contained therein through said needle and into the forward part of said barrel to mix with the component of the charge contained therein, and whereby still further insertion of said plunger into said barrel moves said stopper forwardly in said barrel to expel from said barrel the mixed components of the charge ahead of said stopper through the nipple thereon and a hypodermic needle assembly screwed upon the nipple.

9. In a syringe, a barrel; a stopper slidable axially in said barrel and sealing the interior portion of said barrel on one side of said stopper from that on its opposite side, said stopper comprising a transverse contact portion of easily torn resilient material engaging the walls of said barrel, a stem portion fixed to said contact portion and projecting axially rearwardly thereof toward the rear end of said barrel, and a hollow needle extending axially through said contact portion and said stem portion fixed therein and terminating in a sharpened end beyond said stem portion; and a pin extending radially inward from a wall of said barrel for restraining movement of said stopper forwardly of said barrel; whereby the sharpened end of said hollow needle will pierce a diaphragm pressed upon it and the end of said stem portion of said stopper will press such diaphragm away from said stopper to expel through said hollow needle and past said stopper a fluid confined behind such diaphragm, and whereby further pressure upon the end of said stem portion tears said contact portion against said pin and moves said stopper past said pin.

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