This invention relates to syringes and, more specifically, the instant invention pertains to a hypodermic syringe for use in treating human beings as well as animals.

One of the primary objects of this invention is to provide a disposable hypodermic syringe.

Another object of this invention is to provide a multi-compartment syringe for holding pharmaceutical compositions separate from one another for storage, the syringes being easily prepared for ejection when treatment required.

This invention contemplates, as a still further object thereof, the provision of a multi-chambered hypodermic syringe containing ingredients of an injectable material, the syringe being adapted for quick and easy preparation of the injectable material in fresh condition just prior to administration thereof.

A still further object of this invention is to provide a syringe including piston-like seals as a component part of the injecting plunger.

Another object of this invention is to provide an injector for medicaments which includes means for storing a medicinal compound in powder form, and means for holding a suitable diluent or solvent for the powder separate from the latter, means for mixing the powder with the diluent when desired, and means for ejecting the same from the syringe.

This invention contemplates, as a still further object thereof, the provision of a hypodermic syringe which is non-complex in construction and assembly and which is inexpensive to manufacture.

Other and further objects and advantages of the instant invention will become more evident from a consideration of the following specification when read in conjunction with the annexed drawings, in which:

FIGURE 1 is an exploded perspective view of a hypodermic syringe constructed in accordance with the teachings of one embodiment of this invention;

FIGURE 2 is a vertical, longitudinal, medial cross-sectional view, partly in elevation of the hypodermic syringe shown in FIGURE 1, the syringe being illustrated in its assembled form and loaded with both liquid and solid pharmaceuticals to be mixed and ejected therefrom;

FIGURE 3 is a longitudinal, medial, cross-sectional view, partly in elevation and similar to FIGURE 2, FIGURE 3 illustrating the relative positions of the component elements of the hypodermic syringe when the liquid or solvent for the solid pharmaceutical is to be mixed and dislodged therewith;

FIGURE 4 is a longitudinal, medial, cross-sectional view of the hypodermic syringe shown in FIGURE 1, FIGURE 4 illustrating the connection of the cannula to the syringe barrel and with the plunger in its extreme inward position after an injection has been completed;

FIGURE 5 is a detail cross-sectional view, FIGURE 5 being taken substantially on the horizontal plane of line 5-5 of FIGURE 2, looking in the direction of the arrows;

FIGURE 6 is a detail cross-sectional view, FIGURE 6 being taken substantially on the horizontal plane of line 6-6 of FIGURE 4, looking in the direction of the arrows;

FIGURE 7 is an enlarged fragmentary side elevational view of the hypodermic syringe, partly broken away to illustrate the details of construction of a piston head therefor;

FIGURE 8 is a longitudinal medial cross-sectional view, partly in elevation of a second embodiment of this invention and illustrating the component elements of the hypodermic syringe in their respective positions prior to the movement of certain parts thereof to cause the mixing of two liquid pharmaceuticals with a solid pharmaceutical;

FIGURE 9 is a longitudinal, medial, vertical cross-sectional view similar to FIGURE 8 but illustrating the relative positions of the component elements thereof moved to permit the mixing of two liquid pharmaceuticals with a dry pharmaceutical;

FIGURE 10 illustrates a longitudinal, vertical, cross-sectional view of the relative positions of the several component elements of the hypodermic syringe when loaded with two liquid pharmaceuticals and a dry pharmaceutical and prepared for storage until the syringe is needed;

FIGURE 11 illustrates, in a longitudinal, vertical, medial cross-sectional view the several component elements of the hypodermic syringe after the plunger therefor has been activated to eject the liquid solution through a connected cannula;

FIGURE 12 is a detail cross-sectional view taken substantially on the horizontal plane of line 12-12 of FIGURE 11, looking in the direction of the arrows; and

FIGURE 13 is a detail cross-sectional view taken substantially on the horizontal plane of line 13-13 of FIGURE 11, looking in the direction of the arrows.

Referring now more specifically to the drawings, reference numeral 20 designates, in general, a hypodermic syringe which is seen to include, in a first embodiment thereof illustrated in FIGURES 1 to 7, inclusive, an elongated substantially hollow cylindrical barrel 22 having a plurality of inwardly projecting circumferentially spaced, axially extending ribs 23 formed integral therewith. One end of the barrel is necked down and extended at 24 thereby forming an integrally connected inwardly extending circumferential shoulder 26 therebetween. As will be more fully set forth below, the adjacent merged ends of the shoulder 26 and barrel extension 24 form a valve seat at 27. The lower end of the barrel extension 24, as viewed in FIGURES 1 to 4, inclusive, is closed by an end wall 28 from which downwardly projects a substantially hollow cylindrical cannula mounting boss 30 having a passageway 32 extending therethrough and having its inner end in open communication with the interior of the barrel extension 24. A substantially cylindrical collar 34 also depends from the end wall 28, the collar 34 surrounding the boss 30 in outwardly spaced concentric relation relative thereto. The collar 34 is internally threaded as at 36.

When the hypodermic syringe 20 is not in use, the boss 30 is closed and covered by a substantially cylindrical cap 38 having an end wall 40 extending across the outer end of the boss 30, and a cylindrical side wall 42 engaging against and surrounding the outer side of the collar 34. The cap 38 is completed by providing a nipple 44 which extends laterally from the end wall 42 substantially centrally thereof for seating engagement within the passageway 32.

The upper end of the barrel 22 terminates in an outwardly turned elongated substantially oval-shaped finger engageable flange 46 adjacent its open end, and immediately adjacent the underside of the flange 42 the barrel is formed with a venting and filling opening 48 to which further reference will be made infra.

Reference numeral 50 denotes, in general, the plunger of the hypodermic syringe 20. The plunger 50 includes a plurality of elongated substantially rectangular ribs 52 integrally connected together along one of their longi-
Tuulsionally extending edges in such a manner that each adjacent pair of flanges are disposed, preferably, 90 degrees apart. The ribs 52 are of uniform dimensions and their respective upper ends are centrally and integrally connected with an elongated oval-shaped thumb engageable flange 54. The plunger 59 terminates, at its other or lower end, in a piston 56 integral therewith. The piston 56 includes a main body portion 58 having a diameter greater than the diameter of a circle which could be circumscribed around the outer edges of the ribs 52. At its upper end, the main body portion is integral with an outwardly extending circumferential bead 60. The lower portion of the main body portion 70 having an outwardly projecting upper cylindrical bead 72, a lower depending outwardly flaring skirt 74, and a depending cylindrical piston head 76 surrounded by said skirt 74 and inwardly spaced therefrom to form a circumferential groove 66 therebetween. As is seen in the several figures of the drawings, the piston 56 is normally reciprocable within the barrel extension 24.

Normally reciprocable within the barrel 22 is a second piston 68 having a diameter greater than the diameter of the piston 56 and constructed similarly with respect thereof. The piston 68 is disposed intermediate the ends of the ribs 52 and is integral therewith. The lower portion of the main body portion 70 having an outwardly projecting upper cylindrical bead 72, a lower depending outwardly flaring skirt 74, and a depending cylindrical piston head 76 surrounded by said skirt 74 and inwardly spaced therefrom to form a circumferential groove 66 therebetween.

To prepare the hypodermic spring 20 for use, the cap 38 is installed on the collar 34 in the manner shown in FIGURES 2 and 3 to close off the boss 30. Thereafter, the plunger 54 is removed from the barrel 22 and the barrel extension 24 until the amount of a desired pharmaceutical 78, in solid form, is now deposited in the barrel extension 24. Then, the plunger 54 is inserted within the barrel 22 until the piston 56 seals against its seat 27 thereby sealing off the barrel extension 24 from the barrel 22. A liquid diluent, solvent, or other liquid pharmaceutical 89, of measured volume, is now passed into the barrel 22 through the vent 48, it being noted that the piston 68 is juxtaposed relative to the vent 48 but does not seal it. Thereafter, the plunger 50 is depressed until the upper side of the piston just clears the lower end of the vent 48, but not so far as to cause the skirt 74 to engage with the ribs 23. The syringe 20 may now be stored for subsequent use.

To use the syringe 20, it is necessary to mix the diluent material with the solid material. This is accomplished by pulling upwardly on the plunger 50, that is, outwardly towards the top of the syringe barrel 22 so that the lower piston 56 is moved upwardly away from its seat 27 to permit the passage therebetween of the liquid 90 into the barrel extension 24 containing the solid material 78. The plunger 50 is then moved downwardly within the barrel 22 until the piston 56 again seats against its seat 27 after which the syringe would be shaken until the diluent and the solid were completely in solution. The cap 38 is now removed and the threaded end 82 of a cannula 84 is now threadedly connected with the collar 34 in the conventional manner. The syringe is now ready for use.

As the plunger 50 is now moved downwardly to expel the mixed load within the syringe barrel extension 24, it is, of course, necessary to relieve the air pressure between the barrel 22 and its extension 24. This is accomplished by the conection of the ribs 23 with the piston 68. The piston 68 is formed of a pliable plastic material and thus may be deformed as is illustrated in FIGURE 6, to form an air vent 86 between adjacent portions of the skirt 74, the bead 72 and the ribs 23. This prevents the buildup of air pressure between the larger volume barrel 22 and the lower barrel extension 24 as the plunger 50 is depressed downwardly to expel the mixed medication.

It should be here noted that due to the particular construction of the pistons 56, 68, any increase in pressure within either the barrel 22 or extension 24 will cause the skirts 62, 78 to seal more tightly across adjacent portions of the barrel extension and the syringe barrel. Furthermore, the flange 62 of the piston 56, which acting downwardly to expel the mixed medication tends to effectively resist any back pressures thereon and thereby prevent inadvertent leakage.

As has been stated above, and as now becomes evident from the above specification when considered in conjunction with the drawings, it is an important feature of this syringe that 56 includes a substantially cylindrical, outwardly flaring skirt 62 and an enlarged cylindrical piston head 64 having a diameter less than the greatest diameter of the skirt 62 to provide a circumferential groove 66 therebetween. As is seen in the several figures of the drawings, the piston 56 is normally reciprocable within the barrel extension 24.

A hypodermic syringe such as that described supra may be massed produced at low cost and is, therefore, disposable if the user so desires. It has the additional advantage that it eliminates the necessity for mixing doctors and veterinarians to mix separate components at the time of use since the components elements of a standard medical preparation may be readily stored within the syringe ready for use. This saves much time and also assures that a more accurate dosage would be obtained since the syringe could be filled at a pharmaceutical factory.

FIGURES 8 to 13, inclusive, illustrate a second embodiment of this invention, and wherein counterparts of the elements of the first embodiment of the invention are found in the second embodiment of the invention, the latter elements may be differentiated from the former elements through the addition of a prime mark to the identifying reference numeral.

The syringe according to the second embodiment thereof is designated, in general, by the reference numeral 100 and is seen to comprise, as in the preceding embodiment, a substantially hollow cylindrical barrel 22' which is necked down at one end thereof to form a substantially cylindrical barrel extension 24' integrally connected with the barrel 22' via an inwardly extending substantially cylindrical shoulder 26'. As in the preceding embodiment, a piston seat 27' is formed at the junction of the upper end of the barrel extension 24' with the inner end of the shoulder 26'. The lower end of the barrel extension 24' is closed by an end wall 28' from which projects a hollow tubular boss 30'. A removable cap 38' normally extends across the boss 30' when the syringe is not in use. The hollow cylindrical barrel 22' is provided with a plurality of circumferentially spaced axially extending inwardly projecting ribs 23', an outwardly turned finger engageable flange 46' adjacent its open upper end, and immediately below the flange 46', an opening 48 extends transversely through the barrel 22'.

Slidably mounted within the barrel 22' and its extension 24' is an elongated open ended substantially hollow cylindrical sleeve 102 having an upper side wall 104 and a lower integrally connected side wall 106. As is seen in FIGURES 8 to 11, inclusive, this side wall 104 has a diameter somewhat greater than the diameter of the lower side wall 106. A piston seat 108 is formed at the junction of the adjacent ends of the upper and lower side walls 104, 106.

At substantially the above referred to merger or junction of the upper side wall 104 with the lower side wall 106, the hollow cylindrical member 102 is provided with an outwardly projecting substantially cylindrical flange 110, the latter being adapted to slidably engage the inner surface of the barrel 22'.

The upper side wall 104 is formed with a plurality of circumferentially spaced, axially extending ribs 112 which
project inwardly thereof, and at its open upper end, the side wall 104 is provided with a laterally extending, outwardly projecting flange 114. An opening or aperture 116 extends transversely through the upper side wall 104 immediately below the flange 114.

A plunger 50' identically constructed with respect to the plunger 50 is mounted for reciprocation within the hollow cylindrical member 102. Thus, the plunger 50' comprises a thumb engaging flange 54' at one end of a plurality of ribs 52' arranged and disposed as described before, the plunger 50' at its other end being provided with a piston 56', and intermediate the ends of the ribs 52' the plunger 50' is formed with a second piston 68'.

To locate the hypodermic syringe 100, the plunger 50' is removed from the hollow cylindrical member 102 and the latter is also removed from within the barrel 22'. With the parts of this syringe disassembled, a solid dry pharmaceutical preparation 78' is passed into the lower barrel extension 24' after which the hollow cylindrical member 104 is remounted within the barrel 22' until the lower open end of the cylindrical member 104 seats against the seat 27'. In this position, the flange 110 partially closes the opening or aperture 48' but leaves the same sufficiently open so as to permit the passage of a solvent, diluent, or other liquid pharmaceutical 86'. Since the lower end of the lower side wall 116 is sealed against the seat 27' the liquid 80' will not pass downwardly therebelow. After the measured amount of liquid 80' has entered the barrel 22', the hollow cylindrical member 102 is forced inwardly until the flange 110 presses the lowermost point of the opening or aperture 48', care being exercised not to force the same over the ribs 23'. Thus, the liquid 80' is sealed and held against mixture with the solid pharmaceutical 78'.

Thereafter, the plunger 50' is inserted into the hollow cylindrical member 102 until the piston 56' seals and seats against the seat 108. In this position, the piston 68' partially closes the opening or aperture 116, but leaves the same sufficiently open to permit the passage therethrough of a second fluid comprising a solvent, diluent, or other pharmaceutical liquid 118. The liquid 118 is, of course, of predetermined volume and, after the filling of the cylindrical member 104, the plunger 50' is further depressed until the piston 68' passes the lower opening or aperture 116. Since the piston 56' seals against the lower side wall 116 the liquid 118 will not pass therebeyond to mix with the solid material 78'.

The loaded hypodermic syringe as thus far described has its component elements arranged and disposed in the manner illustrated in FIGURE 10. In the form of the syringe, together with the pharmaceuticals contained therein, may be stored indefinitely and is ready for use at any given time.

To use this compound syringe, and referring now more specifically to FIGURE 9 of the drawings, it is only necessary for the operator to move the hollow cylindrical member 102 upwardly, that is, in a direction to effect the withdrawal thereof from the barrel 22' and its extension 24', this being done only enough to cause the flange 110 to move upwardly above the opening or aperture 48' whereby the seal between the cylindrical member 102 and the shoulder 27' is broken. This permits the solvent, diluent or other liquid compound 80' to descend into the barrel extension 24'. Similarly, the plunger 50' is moved axially of the hollow cylindrical member 102 until the piston 56' clears its seat 106. This permits the diluent or other liquid composition 118 to descend into the barrel extension 24' for mixture with the solid pharmaceutical 78' and the liquid composition 80'.

The cylindrical member 102 and the plunger 50' are now returned substantially to the positions shown in FIGURE 10 and the syringe 100 is now shaken to thoroughly disintegrate the solid material 78' in the two solutions. The cap 38' is now removed and a cannula 84' is connected with the syringe 100 in the conventional manner. Thereafter, the operator forces the plunger 50' and the hollow cylindrical member 102 inwardly causing the contents of the syringe 100 to be expelled. The parts then assume the positions shown in FIGURE 11.

As in the preceding embodiment, air leaks between the several elements are prevented by means of the ribs 23' which are engaged by the flange 110 and the ribs 112 which are slidably engaged by the piston 68'.

Having described and illustrated in detail two embodiments of this invention, it will be understood that the same are offered merely by way of example, and that this invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. A hypodermic syringe comprising an elongated hollow cylindrical barrel having an inwardly projecting shoulder at one end thereof from the innermost end of which projects an elongated hollow cylindrical barrel extension, said innermost end of said shoulder and adjacent portions of said barrel forming a piston seat, an end wall extending across the outer end of said barrel extension, means on said end wall for connecting a cannula thereto in open communication with the interior of said barrel extension, a plunger mounted for reciprocation within said barrel and barrel extension, a piston mounted on one end of said plunger, said piston normally seating against said seat and being reciprocable within said barrel extension, a second piston mounted on said plunger intermediate its ends, said second piston being reciprocable within said barrel and being normally located adjacent the other end thereof, said pistons dividing said syringe into a pair of chambers, and said barrel having an opening extending transversely therethrough adjacent said other end of said barrel, said opening being disposed proximate the outer side of said second piston when the latter is in its said normal position.

2. A hypodermic syringe comprising an elongated hollow cylindrical barrel having an inwardly projecting shoulder at one end thereof and an opposed open end, said shoulder having integral therewith at its innermost end, one end of an elongated hollow cylindrical barrel extension, the innermost end of said shoulder and proximate portions of said one end of said barrel extension forming a piston seat, said barrel having an opening extending transversely therethrough adjacent said other end thereof, a plunger mounted for reciprocation in said barrel and barrel extension, a piston mounted on the inner end of said plunger for reciprocation in said barrel extension, said piston normally seating in said seat and forming with said barrel extension and said end wall a hollow chamber to receive a solid pharmaceutical, a second piston mounted on said plunger intermediate its ends, said second piston being reciprocable within said barrel, said second piston being normally disposed inwardly of said open end of said barrel and inwardly of said opening to form with said barrel, and said first piston, a second chamber to receive a solvent, diluent or other liquid pharmaceutical, said liquid being admitted to said first chamber for mixing with said solid upon movement of said plunger in a direction away from said end wall to unseat said first piston from its said seat, and said solution being ejected from said first chamber by said first piston and through said cannula by movement of said plunger rod in the reverse direction.

3. A hypodermic syringe as defined in claim 2, wherein said barrel is provided with a plurality of circumferentially spaced axially extending ribs, said ribs extending from points proximate said shoulder and terminating at points spaced inwardly of said opening, and said pistons being formed of a deformable plastic material.

4. A plural chamber hypodermic syringe comprising an
The elongated hollow cylindrical barrel having an inwardly projecting shoulder at one end thereof and an opening extending transversely therethrough adjacent its other end, said other end being open, said barrel having a plurality of circumferentially spaced internal ribs formed thereon extending axially thereof from points adjacent said shoulder to points spaced inwardly of said opening, said shoulder at its outer end merging with one end of an elongated substantially hollow tubular barrel extension having an end wall extending transversely thereacross, said merging shoulder and one end of said barrel extension forming a seat, means on said end wall for effecting connection with a cannula to place the same in open communication with the interior of said barrel extension, an elongated hollow tubular cylindrical member having opposed open ends and a flange projecting laterally therefrom intermediate its said ends, said cylindrical member being reciprocable in said syringe, said member having the inner end thereof adapted to normally seat against said seat and said flange normally engaging said barrel between said opening and the adjacent ends of said ribs, said shoulder, barrel, flange and adjacent portions of said cylindrical member forming a sealed liquid retaining chamber, said cylindrical member having an internal cylindrical seat intermediate its respective ends forming a piston seat, said cylindrical member adjacent its other or outer end having an opening extending transversely therethrough, said cylindrical member having a plurality of circumferentially spaced axially extending internal ribs, said ribs extending substantially from said seat to said opening formed in said cylindrical member, a plunger mounted for reciprocation within said cylindrical member, a piston mounted on one end of said plunger, and a second piston mounted on said plunger intermediate the ends thereof, said first piston normally seating against said last named seat and forming a second compartment with said cylindrical member, said barrel extension and said end wall to receive a solvent material therein, said second piston being normally interposed between said opening in said cylindrical member and the adjacent ends of said ribs formed thereon, and said first and second pistons and portions of said cylindrical member therebetween forming a third liquid chamber.

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