

[54] **TWO-COMPARTMENT ASPIRATING
DISPOSABLE HYPODERMIC SYRINGE
PACKAGE**

[75] Inventors: **Anthony Abbey**, Milltown; **Robert
Clayton Squire**, Dover, both of N.J.

[73] Assignee: **American Cyanamid Company**,
Stamford, Conn.

[22] Filed: **Mar. 7, 1972**

[21] Appl. No.: **232,440**

[52] U.S. Cl. **206/47 A**, 128/218 M, 128/272,
206/63.2 R, 206/43, 222/80

[51] Int. Cl. **B65d 25/08**, B65d 81/32

[58] Field of Search 206/47 A, 63.2 R,
206/43; 220/20.5; 128/218 M, 272; 222/80

[56] **References Cited**

UNITED STATES PATENTS

3,595,439 7/1971 Newby 206/47 A

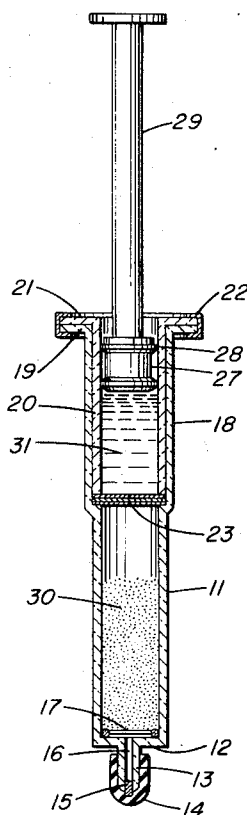
3,684,136 8/1972 Baumann 128/218 M
1,943,120 1/1934 Kabnick 128/218 M

Primary Examiner—William T. Dixon, Jr.
Attorney—Samuel Branch Walker

[57] **ABSTRACT**

A two compartment aspirating disposable hypodermic syringe package consists of a rupturable partially pre-slit diaphragm having a fluorohalocarbon polymer film as a primary moisture-proof barrier across and dividing the syringe barrel into a compartment containing a dry component and a compartment containing a liquid component which components are to be mixed at time of use. A slidable piston in the barrel, on application of pressure, ruptures the diaphragm, permits mixing of the two components, clearing of air, aspiration and injection of the contents as the piston passes over the ruptured remains of the diaphragm.

4 Claims, 7 Drawing Figures



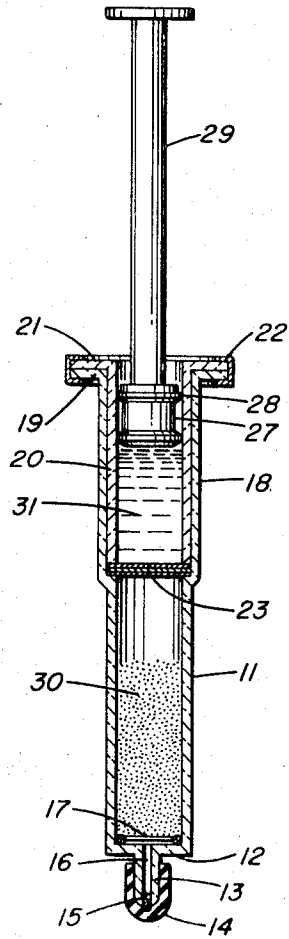


FIG. 1

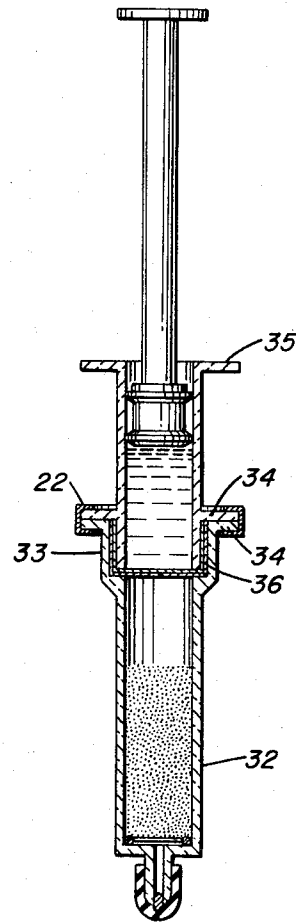


FIG. 2

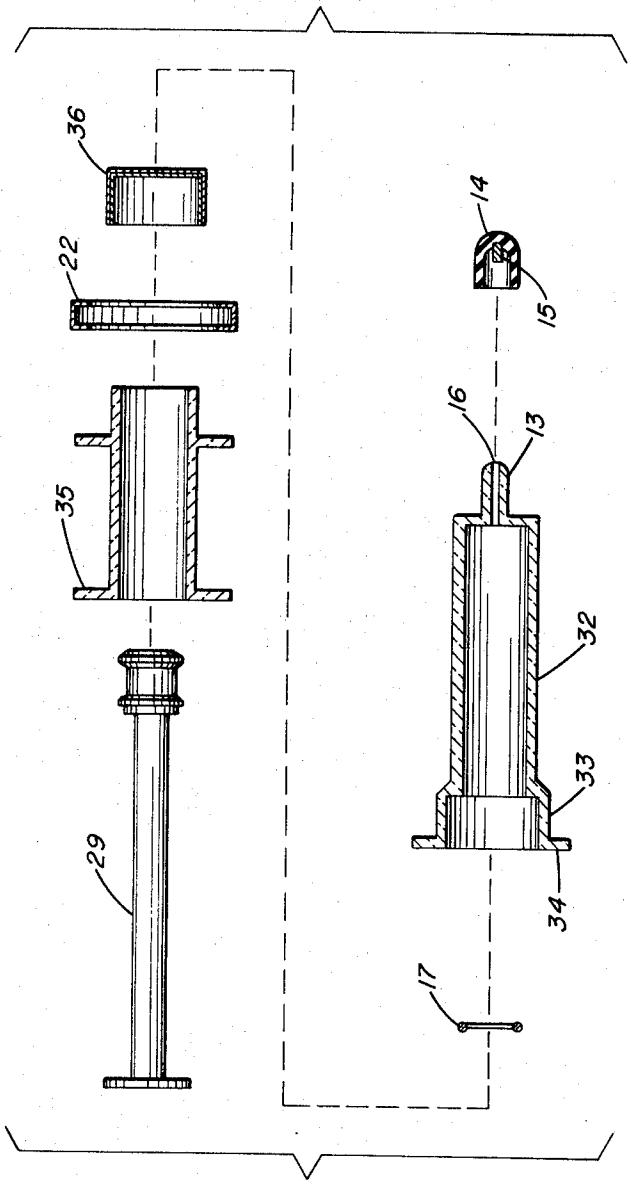


FIG. 3

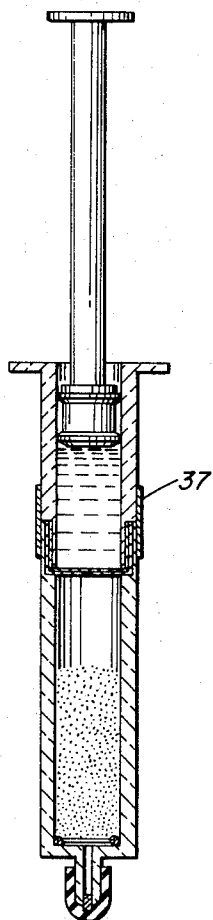


FIG. 4

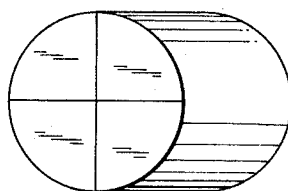


FIG. 5

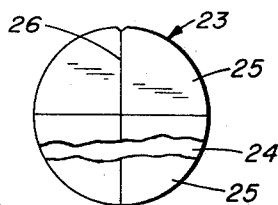


FIG. 6

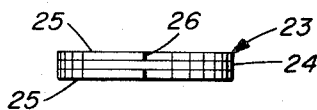


FIG. 7

TWO-COMPARTMENT ASPIRATING DISPOSABLE HYPODERMIC SYRINGE PACKAGE

BACKGROUND OF THE INVENTION

In the treatment of humans and animals there are many medicaments to be injected hypodermically which are not storage stable in the form in which they are to be injected. In many cases, the medication to be injected can be prepared at the time of use by mixing a storage stable dry component and a storage stable liquid component. Sometimes the liquid component contains only water, other times it is water with therapeutic components, synergistic components, solubilizing components, pH control components, or other elements. For the storage of such medication it is desirable that the shelf life be at least 1 and preferably 5 years at ambient room conditions of temperature and humidity. Shorter storage-life packages are only acceptable where the longer storage time cannot be economically attained.

As the package is a single use device, making but one trip from the manufacturer to the point of use, after which the container is discarded, it is desirable that the package have a maximum of product security, a maximum of convenience in use, and a minimum of cost.

These requirements are in part inconsistent and as a result there are many patents and commercial products representing compromises between the various requirements. One such U.S. Pat., of common assignment, is No. 3,161,195, Taylor and Sandhage, TWO-COMPARTMENT ASPIRATING HYPODERMIC SYRINGE, Dec. 15, 1964. This patent describes some of the prior art, some of the problems and some of the expedients which are used. Reference thereto and incorporating by reference is hereby made. U.S. Pat. No. 3,161,195 shows various methods of attaching a needle to the front of the package and various methods of packaging the needle assembly in the operating plunger. Such expedience may be used with the present package and such combinations are within the concepts of the present invention.

Other conventional needle attaching and puncturing mechanisms may be used, as may various carrier assemblies for temporarily or permanently storing the hypodermic needles with the package.

It has now been found that two compartments may be formed by dividing a hypodermic syringe barrel by a diaphragm of a pressure rupturable plastic having at least one layer of a film of a fluorohalocarbon plastic which has an extremely high resistance to water and water vapor and which diaphragm is effectively sealed in moisture proof configuration with the walls of the barrel. Conveniently the barrel is formed in two parts which are in telescoping relationship with the diaphragm being sealed across the end of one of the telescoping sections.

The barrels may be formed of glass or plastic but most conveniently and economically are formed from a translucent or transparent plastic such as linear polyethylene or isotactic polypropylene which is strong, inert to nearly all types of medication, liquid or solid, and is economically worked and formed. Polystyrene, polymethylstyrene, polycarbonates or different plastics or plastic and glass may be used for the different elements. But from the standpoint of cost of raw materials and the cost of manufacture, the polyethylenes and

polypropylenes are presently particularly economically advantageous.

In forming, the front part of the barrel is conveniently formed with a transverse wall means closing the front end of the barrel with either an integral needle or needle attaching means, and very slightly tapered walls, for a solid compartment; and an offset and larger coaxial section for the fitting of the inner telescoping portion of the barrel containing the liquid. A puncturable member may be incorporated at the needle attaching end in order to seal the front end of the front compartment during storage. Conveniently a needle attaching hub is used with a cap over the needle attaching hub giving a moisture proof seal. A filter is conveniently installed in the front of the barrel adjacent to the liquid discharge tip bore to filter out any solid particles or portions of the diaphragm which may be broken loose.

Telescoping part way or all the way into the enlarged rear portion of the front chamber is the compartment adapted to contain the liquid. The diaphragm is conveniently sealed across the front end of the rear compartment and with the telescoping relationship, essentially no stress or strain is placed on the diaphragm to barrel wall assembly and hence compromise during shipment and storage is minimized. A conventional flexible piston having sealing rings is incorporated in the end of the barrel adjacent the liquid and conveniently seals the liquid compartment without air space. The plunger assembly to drive the piston may be of any convenient cross section but conveniently is either a X cross-section for mechanical strength or hollow and adapted to contain the hypodermic needle. The hypodermic needle may be in a sterile package so that it may be removed and attached to the front end of the package without compromising sterility. This method of attachment and the techniques involved are conventional.

Conveniently, but not essentially, the entire barrel assembly has a slight taper and is larger at the rear than at the front. A taper of a few thousands of an inch on the diameter permits a draft in the molding operation so that the molded assemblies may be more easily removed from the mandrel. A taper of about 0.005 inch per inch and, molding manufacturing tolerances are within the sealing characteristics of the flexible sealing rings on the piston and permit economical manufacture.

The characteristics of the diaphragm are such as to insure the permeation of a minimum of water. Many plastics pass water or water vapor when in thin sheets. Plastics of the fluorohalocarbon series such as ACLAR, sold by Allied Chemical Company, have a comparatively slow water vapor transmission rate. The water transmission rate is commercially specified as 0.025 grams per mil per 100 square inch per 24 hours. A Mylar polyester film has a water transmission rate of from 200 to 400 times as great. Low density polyethylene has a water transmission rate approximately 30 times as great as the fluorohalocarbon film. The polyvinyls, polystyrenes and cellulosic films are also comparatively high in their water vapor transmission. Additionally the fluorohalocarbon film has a tensile strength of one-third to one-half of that of Mylar a Mullen Burst strength of around one-third of that of Mylar and a much lower impact strength. These characteristics permit forming a highly water resistant but readily mechanically rupturable seal.

Sealing of the diaphragm to the front of the rear portion of the barrel is accomplished in conventional ways. Among the more rapid and convenient methods is the use of an ultrasonic seal in which either an annular mandrel is used, or a point energy source, which is rotated with respect to the seal, so that ultrasonic energy is concentrated along the area of contact between the diaphragm and the end of the barrel. The diaphragms are cut to size, placed in contact with the rear barrel portion, and as ultrasonic energy is concentrated on the seal area, the discontinuity of an unsealed portion causes the reflection and refraction of energy resulting in intense local heating which fuses the two portions together. Once fused the energy can pass through and heating is reduced. This inherently gives a particularly effective type of seal. Ordinary heat sealing systems may be used with the heating elements shaped to fit the seal area. The diaphragm may be adhesively united to the barrel.

Because of the nature of the usage it is essential that highly reliable seals be formed.

An alternative configuration is to form a cap of the laminate film so that the side walls of the cap slide over the end of the barrel which gives a larger area for sealing of the laminate to the barrel.

In use, as the barrel portions telescope with respect to each other, any stresses and strains are transferred from barrel portion to barrel portion and do not pass through the diaphragm itself. The telescope portions can be held to each other with a clip or clamp or may be adhesively united or heat or ultrasonically sealed to each other. Alternatively, after assembly, by using heat or ultrasonic techniques, the barrel portions can be sealed to each other and also the diaphragm, to give a unitary seal so that in effect the two barrel portions and the diaphragm are a single monolithic piece.

The choice of methods of assembly and techniques to be practiced vary in part with the size of the run, the equipment that is available, and the characteristics of the two components.

Sterility against contaminants is mandatory in hypodermically injected medications.

If the solid component can stand the cycle, the solid component may be filled into its compartment under non-sterile conditions and sterilized by the use of heat, radiation or a sterilizing gas such as ethylene oxide, sufficiently diluted with carbon dioxide or other inert gas as to avoid an explosion hazard. The two portions of the barrel can then be assembled to each other under sterile conditions and the liquid compartment filled and the piston implaced using sterile techniques and sterile components. Alternatively at times, the assembly may be made under non-sterile conditions and sterility achieved by the use of radiation as for example by cobalt 60 beta rays. The effect of radiation, such as the beta rays or X-rays, on the packaging materials must be considered. With some materials even intense radiation during the sterilizing cycle can be used to aid in sealing components together as for example, sealing the diaphragm in to the barrels. With particularly rugged materials, heat sterilization is acceptable. Often with medications which require separate solid and liquid components, the medication may be adversely affected by a heat sterilizing cycle.

Another method of assembly is to assemble the diaphragm into the barrels and the barrels to each other and sterilize the assembly with the solid component

being fed as a powder subsequently through the hole in the needle hub after which the hole is capped, with sterility being attained by ethylene oxide, or other procedures, and the complete assembly being inverted and the liquid compartment sterily filled with liquid and the piston emplaced. Such methods of assembly are within the contemplation of utilization of the present invention. The filling and sterilizing cycles must be chosen with due respect to the characteristics of the medication and the materials of construction of the container.

Without being restricted thereto the present invention is exemplified and shown in the following examples and the accompanying drawings in which:

FIG. 1 is a cross section of a flat diaphragm with a fully telescoped liquid compartment.

FIG. 2 is a cross section of a cap diaphragm with a short telescope.

FIG. 3 is a diagrammatically exploded view showing the various components in section for assembly into the package of FIG. 2.

FIG. 4 is an embodiment in which the diaphragm cap fits in the valve walls with a protective sleeve over the joint between the barrel sections.

FIG. 5 is a view showing the partially slit cap diaphragm.

FIG. 6 is a partially broken away view showing a flat diaphragm.

FIG. 7 is a cross section of a diaphragm showing the partial scoring of a three layer laminated diaphragm.

In the embodiment shown in FIG. 1, a cylindrical barrel 11 of polyethylene has a transverse end wall 12 which wall has a needle tip formed integrally therewith and adapted to fit a standard hypodermic needle hub. Over the needle tip 13 is fitted a protective tip shield 14 having a bore pin 15 which fits into the tip bore 16. A filter 17 which may be woven or felted or paper stock with a thin reinforcing rim is placed against the transverse wall to filter out and prevent the injection of any fine solid particles which may find their way into the assembly.

The rear of the cylindrical barrel is enlarged to form a concentric coaxial external telescoping barrel 18. A finger flange 19 is formed integrally with the rear of the external telescoping barrel. Inside of and cooperating with the external telescopic barrel 18 is the internal telescoping barrel 20 which fits snugly into and is held by the external telescoping barrel 18. A retaining flange 21 on the rear of the internal telescopic barrel fits adjacent to the finger flange 19 and is held thereto by an annular clip 22.

Across the front of the internal telescopic barrel 20 is a diaphragm 23.

An enlarged view of the diaphragm 23 is shown in FIGS. 6 and 7. One configuration as shown in FIGS. 6 and 7 consists of a poly(chlorotrifluoroethylene) film 24 laminated on each side to polyethylene layers 25. The polyethylene layers have score marks 26 over the major portion of their surface. The diaphragm is such size as to fit against and close to the end of the internal telescoping barrel. It is sealed thereto using an ultrasonic generator and a mandrel which is of such size and shape as to give annular seal around the entire external periphery of the diaphragm as it contacts the end of the internal telescoping barrel 20. Preferably the score marks do not extend to the sealed portion or if they do extend to the seal areas, are obliterated during the seal-

ing operation thereby giving a reliably liquid tight seal.

The thickness of the diaphragm is such that it may be readily ruptured by liquid pressure during mixing prior to use. One convenient size is to have an internal diameter of about one-half inch with the poly(chlorotrifluoro-ethylene) layer about 0.001 inch thick, and each of the polyethylene layers about 0.003 inch thick.

Th poly(chlorotrifluoroethylene) may range in thickness from about 1/2 thousandth inch to about 1 1/2 thousandths inch in thickness. For larger syringes a thicker layer and for smaller syringes a thinner layer is convenient. As the polyethylene layers are scored their thickness does not markedly affect the pressure required to rupture.

The complete diaphragm though needs to be thin enough so that when ruptured it will lie against the walls of the barrel without interfering with free passage of the piston 27.

In the barrel is a piston 27 having sealing rings 28 thereon, attached to a stem 29. The piston and stem are conventional in the hypodermic package art. The piston is conveniently formed with a recess into which the end of the operating stem is inserted although detachable screw connections or integral connections may be used. The piston is conveniently of rubber either natural or synthetic and the sealing rings give a higher bearing pressure over a small area for low friction seal to the barrel walls. Conveniently but not necessarily the entire barrel assembly tapers slightly so that the front of the barrel is a few thousandths of an inch smaller in diameter than the rear of the barrel which permits a draft in the mandrel on which the plastic barrel parts are molded. The flexibility of the sealing rings compensates for any minor irregularities from either designed or accidental size variations in the barrels and also permits the piston sealing rings to pass over the residues of the ruptured diaphragm in the barrel.

While not part of the container assembly, as a package, the container has therein a solid medicament 30 in the compartment formed by the transverse wall, the cylinder barrel 11 and the diaphragm 23 and has a liquid component 31 in the compartment formed by the diaphragm, the internal telescoping barrel, and the piston. It is not necessary that either compartment be full. Conveniently the solid medicament is a finely powdered material such as powdered chlortetracycline or a powdered vitamin mixture and the diluent is either water or a saline solution of a liquid mixture of vitamins. Preferably the medicament is in such finely divided form that if moisture leaks in through either the tip shield or past the diaphragm or around and between the internal and external telescoping barrels, the medicament is discolored, and gives warning to the user. If care is used in assembly, such leakers should be few or non-existent.

Alternatively, the internal and external barrel assemblies in the telescoping section may be adhesively united to each other by placing a liquid adhesive composition between them at the time of assembly. Alternatively, the diaphragm and the two barrel sections can be sealed together by a suitably shaped mandrel in contact with an ultrasonic generator and against which the assembly is placed. As the ultrasonic energy is primarily released at points of discontinuity, up until a seal is accomplished between the elements, energy is absorbed and heat generated. Once the plastic unites and becomes essentially homogeneous, energy is passed

through and hence the joint is not over heated even if the more ultrasonic energy than is required is fed into the system.

One suitable diaphragm is commercially available from Allied Chemical Co. under the trademark ACLAR, either 22A for an amorphous film, or better 33C for a crystalline film. These are apparently either a chlorotrifluoroethylene polymer with a small percentage of vinylidene fluoride, or a small percentage of tetrafluoroethylene. Other related types of very moisture resistant films may be used. Laminates with polyethylene are readily handled and fabricated. The moisture resistance is preferably better than about 0.025 grams of water per mil thickness per 100 square inches per day at room temperature. Alternatively, a laminate consisting of aluminum foil sandwiched between two layers of polyethylene film can be utilized as the diaphragm.

In the embodiment shown in FIG. 2, the cylinder barrel 32 is formed with a shorter external telescoping section 33 and a separate assembly rim 34 is formed on both the internal and the external telescopic section forward of the finger flange 35. In this modification, there is sufficient clearance between the internal and external barrel for a diaphragm cap 36. The diaphragm is formed as a cap which can be conveniently molded from sheet stock by a deep drawing operation or by casting, and such cap has the advantage of being integral with the diaphragm portion which stretches across the barrel and has a larger area for adhesive or heat or ultrasonic sealing with the barrel.

By having a cap with a discrete axial length, seal may be formed using an internal mandrel inside of the barrel and an external concentric anvil with pressure being used to transmit heat or ultrasonic energy and press softened materials into sealing relationship with each other. Such construction requires somewhat more specialized equipment and is hence advantageous on the larger production runs.

The parts before assembly are shown in FIG. 3. Other parts are the same as in FIG. 1, and have the same numbers.

The cap type diaphragm as shown in FIG. 5 has walls extended back parallel to the axis to give the additional sealing area with the internal and external barrel portions.

In FIG. 4 is shown a configuration in which the internal and external telescopic sections of the barrels are essentially concentric and coaxial with uniform external walls and without flanges. In this configuration an ultrasonic seal can be used to seal the cap against and between the internal and the external telescopic portions and a sealing band 37 is used to cover and reinforce the joint between the two sections.

The needle hub may be shaped as a mastitis point, or other configuration for appropriate uses.

As the materials of construction vary, the temperature or amount of ultrasonic energy or the type of adhesive composition for sealing can vary widely within the skill in the art. An adhesive which is adapted to unite the materials to be joined or an amount of heat or ultrasonic energy which is adapted in accordance with conventional procedures to secure a substantially perfect union and not over energize and unduly soften the joint is preferred.

As above mentioned in assembly, the assembly techniques can be varied depending upon the characteris-

tics of the medicaments in the two compartments. If the solid and liquid components are both labile and unable to stand sterilizing temperatures, the portions of the barrel are assembled under conventional clean but not sterile conditions and then these portions are sterilized by heat or sterilizing gas such as ethylene oxide with the portions being filled and assembled using sterile techniques for the filling and assembly operations. Such filling and assembly operations are conventional in the industry and are herewith incorporated by reference rather than by further extending the specification.

The stem and the needle hub are illustrated as one conventional configuration. It is to be understood that the needle may be attached in any of the many variations of needles and needle hubs assembly methods which are known to those skilled in the art. The needle tip or for the construction of the stem, which may be hollowed to contain a hypodermic needle in sterile condition preparatory to assembly for use, are also conventional.

Such variations are within the scope of the present invention which is defined by the following claims.

We claim:

1. A combination aspirating hypodermic syringe and two compartment package adapted for storage of separate liquid and solid components of medicaments with internal mixing of the two components to form a single injectable liquid at the time of use, with effective protection of the solid component from the effects of moisture or other components in the liquid compartment during storage, and which maintains sterility during mixing comprising:

a generally cylindrical barrel having a holding flange and at the front end a transverse wall means and transversely of the barrel and in liquid tight relationship therewith, a pressure rupturable plastic dividing diaphragm consisting of at least one film of a material having a high resistance to the permeation of moisture with weakening slits cut into the diaphragm to form cut zones of weakness, which are readily ruptured by liquid operating pressure at the time of use, and which are geometrically small so that the moisture permeation through the slits is over a small area and the predominant area of the diaphragm is much thicker with a correspondingly high moisture impermeability, whereby during

storage the thicker film retards the diffusion of moisture over the major area of the diaphragm, and the thin slits form a readily rupturable zone of weakness,

a flexible piston in the barrel, in a part of the barrel on the opposite side of the diaphragm from the transverse wall means, and in cooperation therewith forming a liquid compartment, flexible sealing rings on the piston to contact the walls of the barrel, which rings are sufficiently flexible to slide readily over and past the diaphragm after rupture, while maintaining a liquid tight seal with the walls of said barrel,

a filter adjacent said transverse wall to filter out and prevent the injection of fine solid particles,

a solid medicament in soluble form in the front compartment for solids formed by the barrel between the diaphragm and the transverse wall means and,

a liquid component in the liquid compartment formed by the barrel between the diaphragm and the flexible piston,

whereby at time of use pressure on the piston transmitted to the liquid behind the diaphragm ruptures the diaphragm and displaces liquid from the rear of the diaphragm into the solid containing chamber in front of the diaphragm whereby the liquid and the solid can be mixed, the solid dissolved in the liquid by shaking, air expelled by pointing the needle end upwards and expressing any air and foam until a clear liquid is obtained, and which assembly permits aspiration on insertion into the subject.

2. The package of claim 1 in which the barrel comprises two telescoping pieces, and the diaphragm is sealed across one end of one of the pieces, to provide a liquid tight seal of the diaphragm to the one such piece, and in telescoping, mechanical stress on the barrel is transferred without stress or strain on the diaphragm.

3. The package of claim 2 in which the front compartment barrel has a shoulder and enlarged rear portion to concentrically receive and retain the liquid compartment in hermetically sealed relationship.

4. The package of claim 3 in which the diaphragm is sealed liquid-tight to both the front and rear compartments.

* * * * *

50

55

60

65