Dec. 25, 1962 S. J. SARNOFF ETAL 3,070,094

MEDICAMENT AND DILUENT STORING, MIXING, AND DISPENSING DEVICE

Filed Feb. 25, 1959

2 Sheets-Sheet 1

Fig. 1.

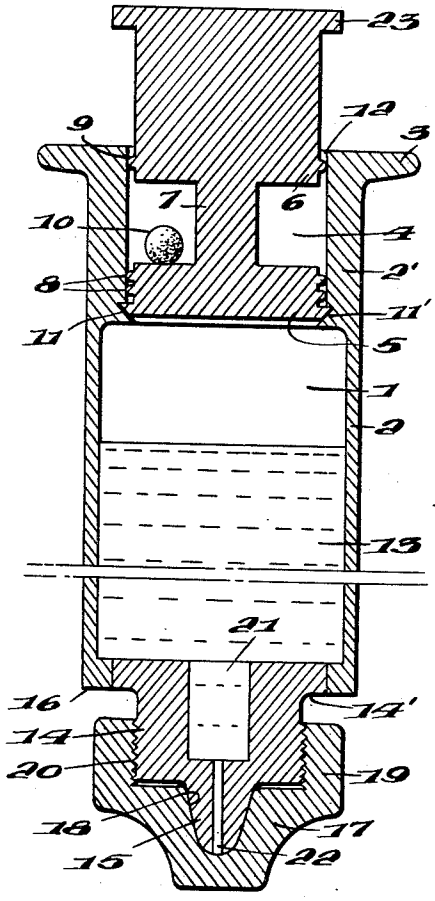


Fig. 3.

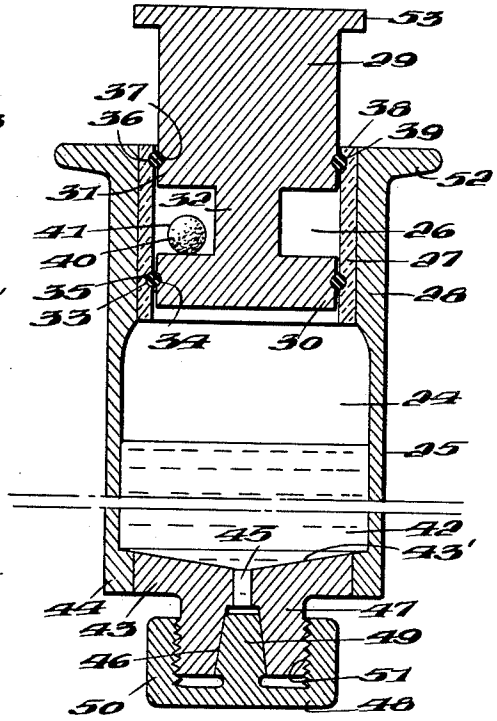


Fig. 2.

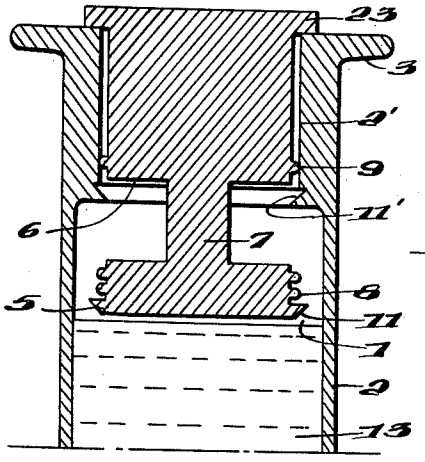
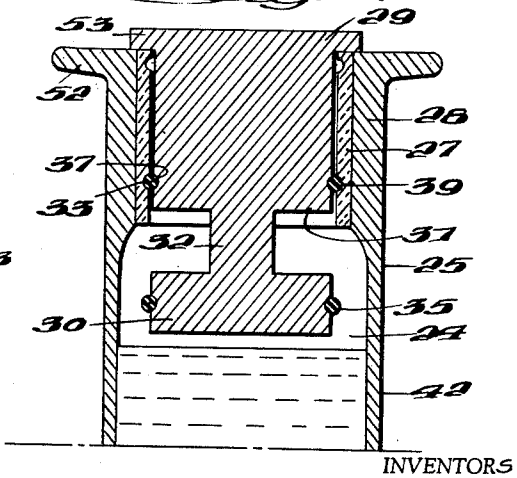


Fig. 4.



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2 Sheets-Sheet 2

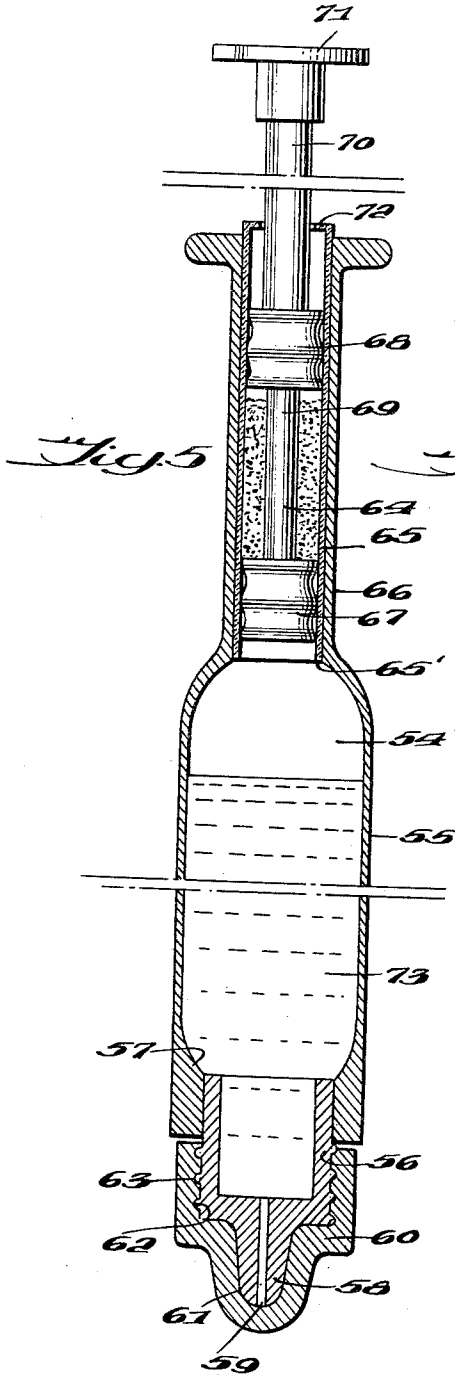

Fig. 5

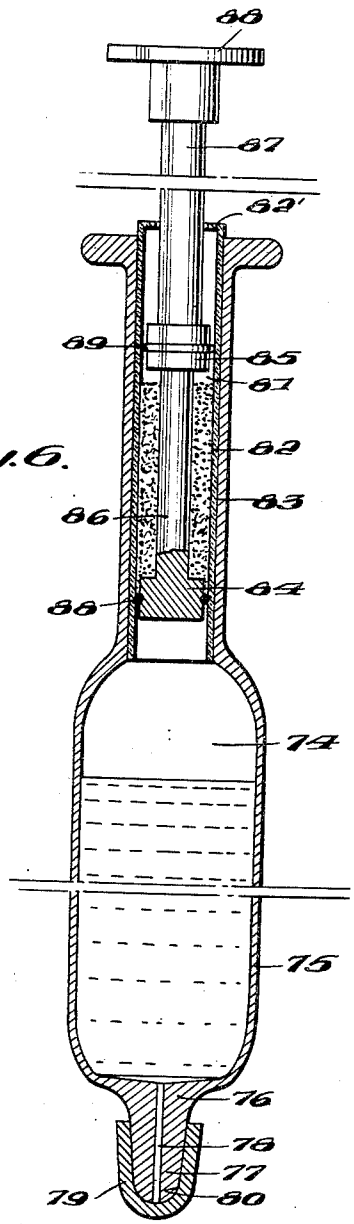

Fig. 6.

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3,070,094
MEDICAMENT AND DILUENT STORING, MIXING, AND DISPENSING DEVICE

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2 Claims. (Cl. 128—272)

This invention relates to improvements in medicament and diluent storing, mixing, and dispensing devices, and particularly to such devices for storing medicament and diluent in separate chambers within a composite device provided with means for efficiently mixing the medicament and diluent and subsequently dispensing the mixture by either drip or syringe type of action without the need of separate handling of the medicament or diluent and with complete safety against contamination or spilling of the medicament during the use of the device.

In medical technology it has often been found that vaccines and other medicaments require special storage facilities, and that in many cases a dried vaccine or other medicament has superior preservative qualities to the same material in its diluted ready-to-use liquid form. It is not unusual, therefore, to make and store vaccine and medicaments in dry form and to mix them with a desired diluent shortly before they are used. This mixing of a dry material with a liquid diluent often entails the use of a plurality of receptacles and, in some instances, a spilling or splattering of vaccine or medicament occurs and may be harmful to the technician preparing the mixture.

It is an object of this invention to provide an improved device for separately storing and for mixing and dispensing a vaccine or medicament and a diluent, which will provide for the ready mixing of the two materials without the possibility of spilling or leaking of the material from the mixing containers during the mixing operation and with a provision for the immediate availability of the mixed materials from the mixing device for use without the need of transferring the mixture to any other container.

It is another object of this invention to provide an improved device for separately storing dry vaccine or medicament and a diluent in predetermined proportions to provide a desired mixture which can be readily prepared within the devices and dispensed directly therefrom after mixture of the materials.

A further object of this invention is to provide an improved device for separately storing and for mixing and dispensing a medicament and diluent in predetermined proportions.

Further objects and advantages of this invention will become apparent from the following description referring to the accompanying drawings and the features of novelty which characterize this invention will be pointed out with particularity in the claims appended to and forming a part of this specification.

In the drawings:

FIG. 1 is a longitudinal sectional view through an improved device incorporating an embodiment of this invention for separately storing and for mixing and dispensing medicament and diluent in which the medicament storage chamber, together with its sealing means and the parts for mixing medicament and diluent, are of greatly simplified construction, with the medicament and diluent chambers in medicament storage relationship, and showing the dispensing end of the device as a drip type dispenser;

FIG. 2 is a longitudinal sectional view of an end of the device shown in FIG. 1, illustrating the relative positions of the medicament and diluent chambers for mixing of medicament and diluent;

FIG. 3 is a longitudinal sectional view of a device incorporating this invention, somewhat similar to the construction shown in FIGS. 1 and 2, in which the medicament chamber is formed entirely of a non-contaminating material, such as glass, which can be completely sealed and evacuated, if desired, and then suitably inserted into a diluent container, as by pressing, to provide for an improved and simplified medicament storing and mixing arrangement, illustrating the medicament chamber in medicament storage position in an end of the diluent chamber, and showing the dispensing end of the device as a syringe type nozzle connector;

FIG. 4 is a longitudinal sectional view of the device shown in FIG. 3, illustrating the relative positions of the medicament and diluent chambers in mixing position;

FIG. 5 is a longitudinal sectional view of a further embodiment of the present invention utilizing a non-contaminating medicament chamber liner and self-sealing piston walls, shown with a drip type dispensing nozzle; and

FIG. 6 is a fragmentary longitudinal sectional view of still another embodiment of the present invention illustrating a variation in the structure of the medicament chamber shown in FIG. 5.

Referring to the drawings, an embodiment of an improved device for separately storing and for mixing and dispensing a medicament or vaccine and a diluent embodying this invention is illustrated in FIGS. 1 and 2, which is particularly convenient in that the device may be held in any desired position for mixing of medicament or vaccine and diluent, and provides for advantageously separately storing of medicament or vaccine and diluent. In this construction, a diluent chamber **1** is provided which is conveniently formed by a substantially cylindrical side wall **2** having a suitable dispensing head of a drip or syringe type secured to one end thereof and formed with a sealing and medicament chamber portion at the opposite end thereof. This latter portion preferably is formed as a thickened sleeve continuation **2'** of the side wall **2**, forming an inwardly extending shoulder at the head of the diluent chamber, and terminates in an outwardly extending substantially radial finger rest or holding flange **3**.

A medicament chamber **4** of smaller diameter than the diluent chamber is formed within the thickened portion **2'** by a pair of inner and outer spaced apart end walls **5** and **6**, respectively, integrally secured together by a central stem **7**. These two walls **5** and **6** and the stem **7**, form a head which is movable axially relative to the diluent chamber **1**. This head is adapted to provide for a complete sealing of the medicament chamber **4** from both diluent in the diluent chamber and the exterior of the device. In order thus to seal the medicament chamber **4**, a suitable seal is provided comprising bead seals, such as the pair of bead seals **8** formed on the outer surface of the inner wall **5** and are adapted to have a snug sealing engagement with the inner surface of the thickened portion **2'**, as shown in FIG. 1, for effectively sealing the medicament chamber **4** from the diluent chamber **1**. The outer side of the medicament chamber **4** is provided with a similar seal comprising a bead seal **9** on the outer surface of the outer wall **6** adjacent to the medicament chamber **4**, and this bead seal **9** is adapted to have a snug sealing engagement with the inner surface of the sleeve portion **2'**.

In order to provide for separately storing medicament or vaccine and diluent in this device, it is assembled by inserting the inner wall **5** of the medicament chamber into the sleeve **2'** until the outer wall **6** almost closes the end of the chamber, leaving a sufficient opening for inserting medicament or vaccine into the chamber **4**. A desired

predetermined amount of medicament or vaccine **10**, in any suitable form, such as powder, crystals, or in a capsule, is placed within the medicament chamber **4**, and the plug forming the medicament chamber and walls then is pressed further into the sleeve **2'** until the bead seal **9** fully seals the medicament chamber on the outer side thereof. If the medicament or vaccine is stored in a capsule, the capsule should be of a type readily soluble in the diluent, so as to facilitate the mixing procedure. This has the advantage of making it possible to use a medicament or vaccine in any suitable form, which can be enclosed in a soluble capsule and stored in this condition. It also facilitates handing of the medicament or vaccine in assembling the device, and further assures against accidental leakage thereof either out of the device or into the diluent chamber during storage periods.

In order to assure the proper location of the bead seals **8** and **9** to provide a completely sealed medicament chamber **4** for storage purposes, the inner wall **5**, which forms a closure between the medicament and diluent chambers, preferably is formed with a tapered or conical outwardly extending latching flange or lip **11**, which is adapted to engage a complementary groove **11'** in the inner side of the sleeve portion **2'** adjacent to the diluent chamber **1**. This lip also latches the plug forming the medicament chamber so as to prevent its withdrawal from the device after it has been assembled, either during its storage or after it has been pressed inwardly for mixing the medicament or vaccine with diluent. This precautionary latching lip arrangement requires that the plug forming the medicament chamber be of a pliable material so that the lip **11** can be deformed as the wall **5** is being pressed into position and can then snap outwardly into the latching position shown in FIG. 1, when it reaches the medicament storing position. In most instances, it will be found desirable to form the plug, comprising the walls **5** and **6**, of a pliable material, such as plastic, as otherwise the bead seals **8** and **9** would have to be made separately from the walls **5** and **6**, as such seals must be readily deformable in order to provide the sealing qualities necessary in such a structure.

After the medicament chamber has been properly assembled within the sleeve **2'**, it generally will be found desirable to provide a light heat seal **12** between the plug forming the medicament chamber and the sleeve **2'**. This conveniently may be formed by heat pressing the outer surface of the thickened wall sleeve portion **2'** against the outer wall **6** of the medicament chamber where these members are formed of a suitable plastic, otherwise any other light heat seal may be placed around the top of the thickened wall sleeve portion **2'**, so as to assure a good seal between this portion and the outer wall **6**.

After the medicament chamber is in position, the device is inverted, and a predetermined amount of diluent **13** is placed in the diluent chamber **1**, making sure that a certain amount of air space is left above the top of the diluent in the diluent chamber, so that when it is desired to mix the diluent and the medicament or vaccine, a part at least of the medicament chamber can be moved into the diluent chamber to allow the medicament or vaccine to pass into the diluent chamber and diluent into the medicament chamber for mixing of the two.

With the diluent in the diluent chamber, this chamber is closed by a suitable dispensing nozzle of either the drip or syringe attachment type. FIG. 1 illustrates a drip type nozzle, preferably formed of plastic, and having a main cylindrical body **14**, with a dispensing nipple **15** on the outer end thereof and a securing flange **14'** on the inner end. The flange **14'** is formed to have a snug fit within an inturned lip **16** on the end of the diluent chamber wall **2** away from the thickened wall sleeve portion **2'**. After assembly of the flange **14'** in lip **16**, these parts are heat sealed together, thus assuring a leak-proof joint therebetween.

During storage, and while mixing diluent and medicament or vaccine, the dispensing nozzle is sealed to prevent passage of liquid from the nipple **15**. Such a seal is conveniently provided by a cap **17** having a socket **18** adapted to fit snugly over the nipple **15** into a tight seal with the outer surface thereof. The cap **17** may be drawn into its sealing position in any suitable manner, as by a screw threaded engagement of a threaded collar **19** with complementary threads **20** on the body **14** of the nozzle. When the diluent and medicament or vaccine have been mixed and its is desired to use the mixture, the cap **17** can simply be unscrewed from the nozzle so as to expose the nipple **15**.

This construction provides a very simple arrangement for mixing the diluent and the material in the medicament chamber by a mere pressing of the outer wall of the medicament chamber towards the diluent chamber so as to move the medicament chamber at least partially into the diluent chamber. This position is preferably determined by pressing the outer wall until it is stopped by engagement of a small flange **23** with the outer edge of the sleeve **2'**, as shown in FIG. 2. In some instances, it may be found desirable to twist the head forming the end walls of the medicament chamber prior to pushing it towards the diluent chamber in order to break the light heat seal **12**. Such a twisting movement also will facilitate pressing of the medicament chamber into communication with the diluent chamber by breaking any possible sticking of the bead seals **8** and **9** with the adjacent surfaces of the thickened wall sleeve portion **2'**. This movement of the medicament chamber partly into the diluent chamber opens a passage between the diluent chamber **1** and the medicament chamber whereby the medicament or vaccine may be dissolved in the diluent, so as to mix the medicament or vaccine with the diluent, thus enabling the medicament or vaccine to pass freely into the diluent chamber from which it may be suitably dispensed, as desired. After the medicament or vaccine and the diluent have been thoroughly mixed, the medicament chamber plug is retracted into the sleeve **2'** to its position with the lip **11** in the groove **11'**. This tends to relieve the pressure in the device to substantially atmospheric pressure and minimizes accidental squirting of the mixture out of the nozzle when the cap **17** is removed for dispensing of the mixture.

The mixed diluent and medicament can readily be dispensed by simply pressing lightly on the side wall **2** of the diluent chamber. This will cause the mixture to pass outwardly through a large passage **21** in the nozzle and a small restricted passage **22** in the nipple **15**.

A variation of the embodiment of the present invention shown in FIGS. 1 and 2 is illustrated in FIGS. 3 and 4, wherein the members forming the medicament chamber are shown as formed of vitreous material, such as glass, ceramic, or similar nondeformable and non-medicament contaminating material. In this construction, a diluent chamber **24** may be formed with a side wall **25** of any suitable configuration ,preferably of pliable plastic and cylindrical in contour, and closed at one end thereof by a suitable dispensing head of the drip or syringe type. A medicament chamber **26** of smaller diameter than the diluent chamber is provided having an outer wall formed by a liner **27**, preferably of clear glass, rigidly secured, as by a suitable press fit, within a thickened wall sleeve portion **28** of the diluent chamber wall **25**. In order to facilitate assembling and operating of the present device, the inner surface of the medicament chamber liner **27** preferably is cylindrical.

As in the previously described embodiment, a medicament chamber-forming plug or head **29** is provided comprising an inner end closure wall **30** and an outer end wall **31** held rigidly in spaced apart relationship by a stem **32**, preferably all integrally formed of a suitable medicament noncontaminating material, such as glass or ceramic. The entire head **29**, including the walls **30** and **31**, are of a size to have a small sliding clearance within the medicament chamber outer wall, and is adapted to be sealed therein

in any suitable manner. Sealing grooves 33 and 34 are formed respectively in the outer medicament chamber wall sleeve 27 and the inner end closure wall 30, adjacent to the diluent chamber 24, and provide for the seating therein of a suitable sealing O-ring 35. This construction assures against the passage of materials between the diluent chamber 24 and the medicament 26 when the device is assembled for storage purposes, as shown in FIG. 3, and also definitely locates the medicament chamber within the liner 27. A similar pair of grooves 36 and 37 are formed respectively in the outer medicament chamber wall sleeve 27 and the outer closure wall 31 adjacent to the outer edge 38 of the sleeve 27, and a sealing O-ring 39 is fitted into these grooves to provide an effective seal against the passage of materials between the medicament chamber and the outside of the device, when it is assembled for storage purposes. As in the previously described embodiment, the diluent chamber 24 is made slightly larger than is necessary for the diluent to be contained therein, as it is necessary that an air space be provided within the diluent chamber 24 to facilitate the pressing of the head 29 partially into the diluent chamber 24 for mixing purposes. Medicament or vaccine 40, in any suitable form, may be placed in the medicament chamber and may be enclosed in a capsule 41 soluble in diluent 42 and is adapted to be placed between the inner and outer end closure walls 30 and 31 of the medicament chamber.

In assembling this device for storage purposes, the medicament chamber-forming head 29 is pressed into the liner 27 until the wall 31 thereof almost meets the end 38 of the liner 27, leaving a space for the insertion of medicament or vaccine. The desired amount of medicament or vaccine then is placed into the medicament chamber and it then is pressed into the liner 27 into position with the sealing O-rings 35 and 39 in engagement with the grooves 33 and 36 in the liner 27, as shown in FIG. 3. This may be done with the liner 27 in or out of the sleeve 28, but preferably the liner 27 first is assembled in the sleeve 28. The device then is inverted and a predetermined amount of diluent 42 is placed in the diluent chamber, being sure to leave a certain amount of air space therein to allow for pressing at least a part of the medicament chamber into the diluent chamber for mixing the contents of these two chambers. The diluent chamber then is suitably closed by a dispensing nozzle of the drip or syringe attachment type. A drip nozzle, such as that shown in the embodiment illustrated in FIG. 2, can be utilized, or a syringe attachment nozzle of the type shown in FIG. 4 can be used. The syringe attachment nozzle preferably is made of suitable plastic and includes a transversely extending flange 43, which forms a closure wall across the end of the diluent chamber and is of a size to provide a snug sealing fit within an inturned flange or lip 44 on the end of the diluent chamber wall 25. In order to assure a secure sealing between the flange 43 and the lip 44, a heat bond between the contacting surfaces thereof preferably also is provided. The inner surface 43' of the nozzle flange 43 preferably tapers outwardly towards the center of the nozzle, terminating in a relatively small passage 45, opening into a tapered socket 46 in a collar 47 and into which an aspirating tip of a syringe is adapted to be placed and with which such a tip forms a snug sliding fit when it is desired to aspirate material from the diluent chamber into a syringe.

During storage, and while mixing diluent and medicament or vaccine, the dispensing nozzle is sealed in order to prevent passage of liquid out of the passageway 45. Such a seal is conveniently provided by a cap 48 having a centrally arranged plug 49, which is complementary in size and shape to the socket 46, such that the plug 49 will have a tight sealing fit within the socket 46 when the cap 48 is drawn tightly over the collar 47. This sealing relationship of the plug 49 in the socket 46 can conveniently be provided by threadedly fastening an axially extending flange or collar 50 of the cap 48 over a complementary threaded surface 51 of the dispensing nozzle collar 47. The cap 48 then can simply be unscrewed from the nozzle, so as to open the socket 46 and the passage 45, when it is desired to dispense the mixture of diluent and medicament or vaccine from the device. With the cap in position over the dispensing nozzle and the device completely assembled, it is ready for storage and may be kept for a considerable period, depending upon the life of the medicament or vaccine 40, as all of the walls forming the medicament chamber are of medicament noncontaminating material, and the sealing O-rings provide for an optimum of storage preservative conditions.

When it is desired to use the medicament, this construction provides a very simple arrangement for mixing of the medicament or vaccine with the diluent by simply pressing the head 29 towards the diluent chamber 24. This relative movement of these members of the device is facilitated by forming a holding flange or lip 52 along the outer edge of the thickened wall sleeve portion 28 and forming a position limiting or stop flange or lip 53 adjacent to the outer surface of the head 29, which will limit the position to which the head 29 can be pressed into the diluent chamber 24, as shown in FIG. 4. Further, as shown in this figure, the sealing O-rings 35 and 39 and the retaining grooves therefor, are spaced longitudinally of the head 29 such that, when the flange 53 engages the outer edge 38 and stops the inward movement of the head 29 into the diluent chamber 24, the outer sealing O-ring 39 will be in a sealing position in the inner O-ring groove 33 at the inner end of the medicament chamber outer wall sleeve 27. In this position of the head 29, the medicament chamber between the closure walls 30 and 31 opens a passage around the outside of the inner medicament chamber wall 30 which permits the mixing of the diluent with the medicament or vaccine 40 by a simple shaking of the device until the medicament or vaccine has been completely dissolved in the diluent. After medicament or vaccine and diluent have been mixed, the medicament chamber plug 29 is retracted into the liner 27 to its storage position, thereby relieving the pressure in the device to substantially atmospheric pressure and minimizing accidental squirting of the mixture out of the nozzle when the cap 48 is removed for dispensing the mixture. The mixture then may be dispensed as desired.

A further embodiment of the present invention is shown in FIG. 5, wherein a device for separately storing and for mixing and dispensing medicament and a diluent incorporating separate diluent and medicament chambers is illustrated provided with a drip type dispensing nozzle. As in the previously described constructions, a diluent chamber 54 is formed with a side wall 55, preferably formed of pliable plastic, and closed at one end by a drip type dispensing nozzle, also preferably formed of plastic securely bonded to the end of the diluent chamber wall 55. This bond is conveniently made by forming the drip type dispensing nozzle with an axially extending body 56 of a size such that the end of the body 56 has a snug sealing fit within an inwardly extending flange or lip 57 formed on the end of the diluent chamber wall 55. A tight fluid sealing bond preferably is formed between the lip 57 and the nozzle body 56 by suitably heat pressing these two members together. The drip nozzle is formed with a nipple 58 on the outer end thereof, having a relatively small central passage 59 therethrough, through which fluid can be dispensed from the device by simply squeezing on the side wall 55 of the diluent chamber.

The dispensing nozzle end of the diluent chamber is adapted to be completely sealed for storage purposes and during the mixing of the diluent and vaccine or medicament. Such a sealing of the dispensing nozzle is con-

veniently provided by a simple cap 60 having a socket 61 therein formed to provide a snug sealing fit with the outer surface of the nipple 58 when the cap 60 is drawn tightly over the dispensing nozzle. The sealing cap 60 is adapted thus to be drawn tightly over the nozzle by simply screwing an internally threaded portion 62 into threaded engagement with screw threads 63 formed on the external surface of the nozzle body 56.

In this construction, medicament or vaccine is adapted to be stored in a medicament chamber 64 of smaller diameter than the diluent chamber. This medicament chamber preferably is formed with a liner 65 of a medicament non-contaminating substance, such as a vitreous material in the nature of glass, ceramic, or the like. This liner 65 is supported within a sleeve extension 66 of the side wall 55 of the medicament chamber, and forms a tight fit therewith. The end walls of the medicament chamber 64 are formed by a pair of pistons 67 and 68 which may be made of any suitable medicament non-contaminating material, such as rubber, which is resiliently deformable. The outer surfaces of the pistons 67 and 68 preferably have an undulating contour so as to form, in effect, a plurality of sealing O-rings or bead seals, which are slightly compressed as these pistons are inserted into the liner 65, thereby forming tight fluid seals with the inner wall of the liner. The inner piston 67 also forms a closure wall for the end of the diluent chamber away from the dispensing nozzle end thereof. The two pistons 67 and 68 are secured rigidly in spaced-apart relationship on a centrally extending rigid force transmitting stem 69, which may extend through the outer piston 68 as an enlarged operating push-rod 70, to the end of which a suitable push-button 71 is secured. It may be found desirable to form the push-rod 70 separate from the piston and stem assembly and to secure the push-rod detachably, as by screw threaded engagement, to the assembly. This would provide a shorter packaged unit and would avoid possibly accidentally pushing of the push-rod and accidentally mixing the diluent and the medicament or vaccine.

In the manufacture of this embodiment of the present invention, the piston 68 and the stem 69 are inserted into the glass liner 65 prior to the assembly of this liner within the sleeve extension 66, and the piston 68 is pushed into the liner to a position wherein the piston 67 is very close to the inner end 65' of the liner 65. This provides for a small amount of clearance between the end 65' of the liner and the adjacent side of the piston 67 through which medicament or vaccine then is inserted into the medicament chamber 64, so as to substantially fill the space between the two pistons 67 and 68. If the push-rod 70 is secured to the piston 68, it then is withdrawn further out of the liner 65, so as to draw the two pistons 67 and 68 completely within the liner, into a position substantially as shown in FIG. 5. If no push-rod 70 is attached to the piston 68, the rigid assembly of pistons 67 and 68 on the stem 69 is pushed into the liner 65 by simply pushing down on the piston 67. The outer end of the liner 65 is formed with a small inturned flange or lip 72 which acts as a stop to prevent the withdrawal of the pistons through the outer end of the liner. Preferably, the liner 65 is longer than the distance between the outer surfaces of the pistons 67 and 68, and the piston 68 is not pushed all the way to the lip 72, but a space is left at this outer end of the liner 65.

After the medicament or vaccine has been placed within the medicament chamber and the pistons 67 and 68 have been drawn into the liner into medicament storage positions, the push-button 71 may be easily fastened to the end of the push-rod 70. If desired, this push-button may be fastened to the end of the push-rod prior to filling the medicament chamber. This assembled medicament chamber with its contents then is pressed into the sleeve 66 to the position shown in FIG. 5. The device then is inverted and a predetermined amount of diluent 73 is placed in the diluent chamber 54, making certain not to fill the chamber and to leave an air space sufficient readily to push the inner piston 67 and at least part of the medicament chamber into the diluent chamber when it is desired to mix the diluent and the medicament or vaccine. The dispensing nozzle body 56 then is pressed into the body flange 57 and is suitably heat or otherwise sealed thereto. The cap 60 is next screwed into sealing engagement over the nozzle and the assembled device is ready for packaging and storing or for use, as desired.

After the medicament chamber has been fully assembled with medicament or vaccine therein, the further assembly of the device can also be completed by first closing the dispensing end of the diluent chamber and then placing the various units in assembled positions in the reverse order to that outlined above. In such a case, the cap 60 is secured in sealing engagement over the nipple 58 and a predetermined amount of diluent 73 is placed within the diluent chamber 54, leaving an air space in the end of the diluent chamber 54 sufficient readily to push the inner piston 67 into the diluent chamber when it is desired to mix the diluent and the medicament or vaccine. The assembled liner 65, pistons 67 and 68, and the medicament in the medicament chamber 64, then are pressed partly into the sleeve extension 66, and the device is inverted. The cap 60 then is removed to relieve pressure in the diluent chamber and the medicament chamber then is pressed into the position shown in FIG. 5. The cap 60 then is replaced on the nozzle 56, and the assembled device is complete. If desired, the push-rod 70 may have a screw threaded engagement with the piston 68 or the stem 69, and may be unscrewed from this engagement for storage purposes, so as to shorten the overall length of the device and also to prevent accidentally pushing the push-rod and its connected pistons towards the diluent chamber during storage periods, as such accidental movement of the pistons would result in a mixing of the diluent and medicament or vaccine, and result in the spoilage thereof.

When it is desired to utilize the medicament or vaccine, the push-rod 70 is simply connected to the piston 68 or to the stem 69, and pressure is applied to the push-button 71, while the cap 60 remains in sealing relation over the nipple 58, so as to cause the medicament chamber 64 to move relative to the diluent chamber 54 by the relative movement of the pistons 67 and 68, until a passage is provided between these chambers as the piston 67 passes completely out of the liner 65 into the diluent chamber 54. The medicament and the diluent then may be readily mixed by a simple shaking of the device, and the medicament then will pass into the diluent chamber for dispensation in its mixed diluted state through the nipple 58. After the mixing is completed, the medicament chamber pistons and stem preferably are withdrawn into the liner 65, so as to relieve pressure within the diluent chamber and to restore it to atmospheric pressure. If desired, the piston assembly may even be withdrawn into the space, shown above piston 68 in FIG. 5, until piston 68 engages the lip 72, so as to form a slight reduction in pressure in the diluent chamber, thereby further assuring against accidental squirting of the mixture out of the nozzle when the cap 60 is removed. Dispensing of the mixture may be readily obtained by simply removing the cap 60 and squeezing the side 55 of the diluent chamber.

A further embodiment of the present invention for separately storing and for mixing and dispensing medicament and diluent is illustrated in FIG. 6. This construction is very similar to that shown in FIG. 5, and includes a diluent chamber 74 having a side wall 75 closed at one end thereof by an integral end wall 76, which terminates in an integral nipple 77 having a relatively small fluid passage 78 therethrough. The walls 75 and 76 of the

diluent chamber and the nipple 77 preferably are formed of suitable pliable plastic, and a cap 79, also preferably formed of plastic, with a socket 80 therein, is adapted to have a snug sealing friction fit over the outer surfaces of the nipple 77, so as to seal this end of the diluent chamber by simply pressing it over the end of the nipple.

As in the FIG. 5 construction, a medicament chamber 81, of smaller diameter than the diluent chamber, is provided which includes a liner 82 of medicament non-contaminating material, such as glass or ceramic, which is press fitted in snug engagement within a sleeve extension 83 of the diluent chamber wall 75. The end walls of the medicament chamber 81 are formed by a pair of spaced apart pistons 84 and 85, which are held rigidly in spaced apart relationship and secured together by a rigid stem 86. The two pistons 84 and 85, and the stem 86, preferably are formed as a single molded unit of suitable material, such as plastic or glass, with the pistons of a size to have an easy sliding clearance within the liner 82. In order to operate the device, a push-rod 87 is secured to the outer piston 85 and is provided with a push-button 88 on the outer end thereof. The push-rod 87 may be secured to the piston 85 by screw threaded engagement therewith, similar to the construction of FIG. 5, or it may be molded integrally with the pistons and the stem 86. The formation of the push-rod 87 and the push-button 88 as a separate unit from the pistons 84 and 85 and the stem 86 has the advantage that these two members of the unit may be separated for packaging, so as to form a smaller package and also obviate the possibility of accidentally pushing the pistons into the diluent chamber and thereby mixing the diluent and the medicament or vaccine during storage.

In order to obtain a good seal between the diluent chamber and the medicament chamber a sealing O-ring 88 of suitable material, such as rubber, is mounted in a circumferentially extending groove in the cylindrical wall of the piston 84, and this O-ring 88 is adapted to be compressed into tight sealing engagement with the inner surface of the liner 82 as the piston 84 is drawn into the liner. The outer end of the medicament chamber 81 is similarly adapted to be sealed against leakage or spillage of medicament or vaccine out of the medicament chamber by another sealing O-ring 89 mounted in a circumferentially extending groove in the cylindrical surface of the piston 85, and this sealing O-ring 89 also preferably is formed of rubber and of a size so as to be compressed into tight sealing engagement with the inner surface of the liner 82 as the piston 85 is drawn into the liner.

The assembly of this embodiment of the device involves essentially the same steps as the embodiment shown in FIG. 5, and similarly medicament or vaccine first is placed within the medicament chamber 81 in the liner 82, and an inturned flange or lip 82' acts as a stop to prevent drawing the piston 85 out of the outer end of the liner 82. The cap 79 then is placed over the nozzle 77 and the desired amount of diluent is placed in the diluent chamber 74. The assembled medicament chamber is pressed into the sleeve 83 and the device then is inverted and the cap 79 is removed so as to relieve the pressure within the diluent chamber. The cap 79 then is replaced over the nozzle for storage purposes. If desired, the medicament chamber can be assembled first in the sleeve 83, and diluent placed in the diluent chamber through the restricted passage 78 by the conventional method of filling containers with restricted orifices such as lotion bottles.

Mixing of medicament or vaccine and diluent in a device of this type, is performed in the same manner as with the embodiment shown in FIG. 5. Dispensing of a mixture of diluent and vaccine or medicament from the device is readily obtained by simply removing the sealing cap over the dispensing nozzle and pressing lightly inwardly on the side 75 of the diluent chamber. As can be readily understood, the dispensing nozzle in this construction may readily be made in the form of a syringe nozzle dispenser, similar to that shown in FIG. 4.

While particular embodiments of this invention have been illustrated and described, modifications thereof will occur to those skilled in the art. It is to be understood, therefore, that all arrangements and constructions within the spirit and scope of this invention are intended to be covered by the appended claims forming a part of this application.

We claim:

1. A device for separately storing and for mixing and dispensing a medicament and a diluent including a container forming a diluent chamber and having a deformable side wall portion, means including a container portion extending from and integral with said diluent chamber container forming the side walls of a medicament chamber, a piston member comprising an inner and an outer piston unitarily secured together in spaced relationship and slidably arranged in sealing relationship with said medicament chamber container portion side walls and forming end walls for said medicament chamber, said inner piston being adapted to form a closure between said chambers when slidably engaged with said medicament chamber container portion and being smaller in area than the adjacent corresponding transverse area of said diluent chamber whereby sliding movement of said inner piston into said diluent chamber opens a passage between said chambers providing for mixture of the medicament and the diluent and providing for passage of the medicament into the diluent chamber, said diluent chamber having a dispensing portion removed from said medicament chamber container portion, and stop means for limiting the movement of said inner piston into said diluent chamber to a position which avoids interference with said dispensing portion.

2. A device for separately storing and for mixing a medicament and a diluent including a diluent chamber comprising a tubular member having a deformable side wall portion, a sleeve of reduced diameter extending from said diluent chamber, a liner of medicament non-contaminating material mounted in said sleeve, means forming a medicament chamber including a member comprising an inner and an outer piston unitarily secured together in spaced relationship and slidably arranged in said liner, said pistons forming end walls of said medicament chamber, means for forming fluid seals between said pistons and said liner, said inner piston being arranged in said liner so as to form a closure between said chambers, said medicament chamber forming member being arranged for movement relative to said diluent chamber to provide a direct passage between said chambers by movement of said inner piston into said diluent chamber whereby the medicament and the diluent may be mixed and the medicament may pass into the diluent chamber, said diluent chamber having a dispensing portion removed from said medicament chamber, and stop means on said medicament chamber forming member for limiting movement of said inner piston into said diluent chamber to a position assuring against interference of said inner piston with said dispensing portion of said diluent chamber.

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