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SPECIFICATION

SYRINGE

Technical Field

The present invention relates to a kit style syringe previously filled with medicine in a syringe cylinder, and more particularly intends to improve the sealing performance in order to prevent invasion of bacteria and vapor during safekeeping and in sterilization.

Background Art

Japanese Patent Publn. No. 62-58745 proposes a kit style syringe as disclosed in Fig. 23 which can be previously filled with medicine and permits injection to be easily performed by only attaching a syringe needle in injection. As shown in Fig. 23, a syringe 63 includes a glass cylinder body 64, a barrel of synthetic resin fixedly fit into the front of the cylinder body 64, and a cap 70 of synthetic resin mounted on a syringe needle connection portion 69 at the tip of the barrel 65. A slidable partition stopper 66, a piston 67 and a medicine solution filled therebetween are arranged in the cylinder body 64. The barrel 65 and cylinder 64 constitute a syringe cylinder.

The barrel 65 has an inner diameter equal to

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that of the cylinder body 64. On the inner wall of the barrel 65 are formed a longitudinal groove 71 and a delivery groove 72 extending from the groove 71 to a discharge hole 73 of the needle connection portion 69. In operation, when a piston 67 is pushed, the partition stopper 66 moves into the barrel 65. Then, the medicine 68 will be introduced into the discharge hole 73 through the grooves 71 and 72. A syringe needle is lure-locked with the needle connection portion 69 which is tapered, i.e., surely fixed there by elasticity peculiar to resin.

The cap 70 is fixedly fit on an external cylinder 74 formed around the needle connection portion 69 of the barrel 65 as seen from an enlarged view. Specifically, a peripheral groove 75 is formed on the side of the inner wall of the external cylinder 74. A protrusion 79 of a circular engagement hem 77 dangling from a flange of the cap 70 is engaged with the peripheral groove 75 so that the flange 76 intimately abuts on the external cylinder 74. The cap 70 serves to prevent invasion of dust during safekeeping.

But, the syringe 63 described above can inject only one kind of medicine. Where two or more kinds of injection agents, e.g., agents A and B should be mixedly injected, these two kinds of injection agents

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must be mixed previously. In this case, even where the agents A and B exist solely, respectively, and can be stably preserved for a long time, it may be difficult to maintain the stability in the mixed state of A + B.

A syringe which permits two kinds of medicines to be separately preserved has been proposed in Japanese Utility Mode Preliminary Publn. 3-58434. This syringe (not shown) has a structure similar to that explained above in connection with the above Japanese Patent Publn. 62-58745, in which another partition stopper is arranged between the partition stopper 66 and the piston 67 to permit two kinds of injection agents to be accommodated. This syringe, in which the shape of a passage in the barrel is slightly modified, has basically the same structure as that of the syringe disclosed in Fig. 23.

In any syringe described above, however, the barrel 65 must be fabricated as a separate component and attached to the tip of the cylinder 64. Such a syringe is too expensive to dispose because the structure of the barrel is complicate and requires high accuracy.

Meanwhile, filling of medicine solution and insertion of partition stoppers in the syringe are carried out by the vacuum filling/stopping technique

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as shown in Figs. 24(a) and 24(b). In this technique, first, as shown in Fig. 24(a), a front partition stopper 37_1 is inserted into the front of the cylinder 36 and thereafter the first medicine solution 42 is injected from a solution nozzle 38. In this case, the interior of the cylinder 36 is evacuated to prevent mixing of air in the medicine solution 42.

Next, as shown in Fig. 24(b), a partition stopper 37 pushed into a metallic cylindrical tube 39 by reducing its diameter is instantaneously pushed out into the cylinder 36 using a push rod 40. At this time, air between the medicine solution 42 and an intermediate partition stopper 37_2 slips out of a slit 41 between the cylindrical tube 39 and the cylinder 36 as indicated in arrows. A second medicine solution is injected in an evacuated state. Thus, a separate-injection style syringe can be fabricated. The conventional syringes, however, have a defect that when the cylinder 36 is filled with the medicine solution 42, air is apt to remain in a peripheral groove 43 of the intermediate partition stopper 37_2. Further, the conventional syringes have also the following defect. Where the air remains in the peripheral groove 43, when the intermediate partition stopper 37_2 moves in a vacant chamber of

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the barrel 65 in Fig. 23, air will be mixed in the medicine solution 42. For this reason, the syringe must be once pulled out from a human body to evacuate. When bacteria are mixed in the air remaining in the peripheral groove 43, they will invade the medicine solution 42.

On the other hand, Japanese Patent Preliminary Publn. 60-72561 proposes a syringe 51 as shown in Fig. 25. This syringe includes a glass cylinder 53 having a swelling groove 52 in the intermediate portion, a rubber partition stopper 54 arranged behind the groove 52 within the cylinder 53, a piston 55 behind the partition stopper 54, a front chamber 56, i.e., medicine powder 58 accommodated between the syringe needle connection portion 57 at the front and the partition stopper 54, a rear chamber (i.e., diluted solution 59 filled between the partition stopper 54 and the piston 55), and a rubber cap 60 covering the syringe needle connection portion 57.

The rubber cap 60 shuts a discharge hole 61 of the syringe needle connection portion 57 to prevent vapor absorption of medicine powder 58 during safekeeping of the syringe 51. In using the syringe 51, the piston 55 is pushed to move the piston 55 to the groove 52 of the cylinder 53. As a result, the diluted solution 59 is injected into the front

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chamber 56 so that it will be mixed with the medicine powder 58 by stirring.

These syringes 51 and 63 described above permit persons engaged in medical treatment to remove the caps 60 and 70, mount a syringe needle and immediately give a patient an injection without labor of filling medicine solution. As compared with the conventional syringes, these syringes can prevent inconveniences of pollution of a syringe needle in sucking medicine solution, mixing of glass pieces due to ampul cutting in filling the medicine solution and mixing of minute fragments of rubber or invasion of bacteria in thrusting the needle through the rubber stopper of a vial.

The syringe 51, 63 is required to conduct pre-sterilization and post-sterilization under rules of FDA in U. S. A. The pre-sterilization is carried out for each of components in the process of making the syringe, and the post-sterilization is carried out upon completion of assembling the components. The post-sterilization is carried out by e.g. spraying of flowing steam at 120° for 20 minutes. Thereafter, the syringe is wrapped. The wrapping is performed in an aseptic room by using a sterilization sack made of vinyl and further vacuum packing the sterilization sack. After the wrapping, the syringes must be

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preservable for two or three years.

However, the syringe described above suffers from the following serious problem. In addition to that the cap 60, 70 is apt to come off, in the post-sterilization, steam will invade from an opening of the cap 60, 70 and a small opening between the barrel 65 and the cylinder body 64 as indicated by character a and b in Figs. 23 and 25. Bacteria are apt to invade. This is because a minute opening will occur even when the barrel 65 made of synthetic resin and glass cylinder 64 made of glass are pressure-coupled with each other. Further, even if the post-sterilization is successful, when a small hole is made in the sterilization sack during safekeeping after the wrapping or the bacteria killing of the sack is not complete, bacteria will invade from openings of the cap 60, 70 and the barrel 65.

In view of the above points, in order to realize three rules of the kit style syringe, i.e., reduction in burden, prevention of mixing of alien substance and destruction of bacteria pollution in preparing medicine, the present invention intends to provide a syringe with excellent sealing performance which can prevent invasion of bacteria and others during a long time preserving time or the sterilization step using flowing steam.

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Disclosure of Invention

In order to attain the above object, the present invention adopts a first configuration comprising: a cylinder having openings on both ends and a communicating passage provided near the one opening in an axial direction and from whose other opening a piston is inserted; a partition stopper which is slidable within said cylinder and defines a plurality of chambers in said cylinder; an elastic end partition having a passage in a radial direction fit on the one opening side of said cylinder and guided to said communicating passage and another passage in an axial direction communicating with said passage; and a rigid syringe connection portion fit in said passage in an axial direction of said end partition. Said syringe needle connection portion may have rotation stopping protrusions in a radial direction and said end partition may have fitting grooves corresponding to said rotation stopping protrusions.

In the first configuration, the elastic partition end is pressed into the front end of the rigid cylinder to make intimate contact with each other, thus preventing invasion of water and bacteria into the cylinder. The rigid syringe needle connection portion is pressed into the passage in an axial direction of the elastic partition end to make

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intimate contact with each other, thus similarly preventing water or bacteria into the cylinder. The rotation stopping protrusions of said syringe needle connection portion are fit in the fitting grooves of the partition end, thus preventing rotation of the syringe needle connection portion in lure-locking connection of said syringe needle.

As another means, the present invention adopts, in a syringe in which medicine solution is filled between a partition stopper arranged slidably in a cylinder and a rear piston, and in the outer periphery, a plurality of circular lips and a peripheral groove between said plurality of lips are formed, a second configuration wherein a communicating portion communicating said medicine solution with said peripheral groove is formed. The peripheral grooves may be formed in said rear piston and a communicating portion communicating said grooves with said medicine may be formed in said rear piston. The communicating portion may be communicating grooves formed in said circular lips of said partition stopper or said rear piston.

In accordance with the second embodiment of the present invention, the peripheral groove of the partition stoppers or piston is filled with the medicine solution. For this reason, no air is left

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in the peripheral groove and there is no fear of bacteria in the air invading the cylinder. Where two partition stoppers are arranged in the cylinder, the front partition stopper is first inserted in the cylinder and the first medicine solution is injected under ventilation. Next, the second intermediate partition stopper is built in by the vacuum filling/stopping technique. The medicine is filled in the peripheral groove of the intermediate partition stopper to extrude air in the peripheral groove. Thus, the second medicine solution is injected. Where the intermediate partition stopper is mounted in a reverse direction, in injection of the second medicine solution, air in the peripheral groove from the communicating portion (communicating groove) is absorbed by ventilation.

As still another means, the present invention adopts, in a syringe including a syringe needle connection portion and an external cylinder for protection outside said syringe needle connection portion which are formed at the tip of a cylinder made of synthetic resin, a third configuration that a tip hermetic-sealing portion for hermetically sealing said syringe needle connection portion in said external cylinder is integrally formed at the tip of said external cylinder. The tip hermetic-sealing

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portion may include a head fixed at the tip of said external cylinder through a circular recess groove, and a twisting plate extended from said head. Further, said cylinder may be a resin-integral type cylinder in which said partition stopper and said rear piston are slidable, and a communicating groove for introducing medicine solution successive to a discharge hole of a syringe needle mounting portion is formed in a front vacant chamber of said cylinder. Said front vacant chamber partitioned by said partition stopper may be sealed with gas. The material of said cylinder is made of amorphous polyolefin and others.

In the third configuration, the syringe needle connection portion is surrounded by the external cylinder and the tip hermetic-sealing portion so that it is completely sealed. By twisting the twisting plate, the tip hermetic-sealing portion can be cut from the circular recess groove between the head and the tip of the external cylinder. Further, in unsealing the tip hermetic-sealing portion, the gas pressure in the cylinder and the front partition stopper jointly stop invasion of bacteria from the syringe needle connection portion. The resin integral style cylinder can solve invasion of flowing vapor from the cylinder intermediate portion of the

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barrel style cylinder. Since the amorphous polyolefin can be easily molded, the communicating groove can be easily and surely formed in the cylinder, and the cylinder can be burned up.

Brief Description of Drawings

Fig. 1 is shows a first embodiment of the syringe according to the present invention; (a) is a sectional view showing the structure, (b), (c) are sectional views showing the operation and (d) is a sectional view in line I - I of (a).

Fig. 2 is an exploded perspective view showing an end partition, a needle connection portion and a cap.

Fig. 3 is a sectional view in line III - III in Fig. 2.

Fig. 4 is a perspective view of a similar example of the partition and the cap.

Fig. 5 is a sectional view in line III - III in Fig. 4.

Fig. 6 is back view of the end partition of Fig. 5; (a) shows a similar example, and (b) shows the other example.

Fig. 7 shows another example of the syringe needle connection portion; (a) is a front view and (b) is a sectional view in IV - IV of (a).

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Fig. 8 is a separate injection type syringe filled with two kinds of injection agents; (a) is a sectional view showing the structure, (b) and (c) are sectional views showing the operation.

Fig. 9 is a mixing type syringe using two kinds of injection agents; (a) is a sectional view showing the structure and (b) and (c) are sectional views showing the operation.

Fig. 10 is a sectional view of the main part showing the other embodiment of a cylinder.

Fig. 11 is a longitudinal sectional view of the second embodiment of the state where the end partition and the cap in Fig. 5 are mounted in the cylinder.

Fig. 12 is a longitudinal sectional view showing the second embodiment of the syringe according to the present invention.

Fig. 13 is a front view showing an intermediate partition stopper build in the cylinder.

Fig. 14 is a perspective view showing the intermediate partition.

Fig. 15 is a longitudinal sectional view showing the third embodiment of the syringe according to the present invention.

Fig. 16 is a perspective view showing the cylinder portion of the syringe.

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Fig. 17 is a perspective view of a first example of a sealing structure.

Fig. 18 shows a sealing structure; (a) is a plan view and (b) is a side view partially sectioned in unsealing.

Fig. 19 is a perspective view showing the second example of the sealing structure.

Fig. 20 is a longitudinal sectional view showing the third example of the sealing structure.

Fig. 21 is a plan view of the third example.

Fig. 22 is a longitudinal sectional view showing a syringe equipped with a sealing structure.

Fig. 23 is a longitudinal sectional showing one example of the conventional syringe.

Fig. 24 shows an evacuation filling stopping technique; (a) is a sectional view of the state where the first medicine solution has been injected and (b) is a sectional view of the state where an intermediate partition stopper has been build in.

Fig. 25 is a longitudinal sectional view showing the other example of the conventional syringe.

Best Mode of Carrying Out the Invention

Embodiment 1

Fig. 1(a) - (d) show the first embodiment of the syringe according to the present invention. Fig.

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1(a) shows the state before use, Fig. 1(b) shows the state during injection, Fig. 1(c) shows the state after injection, and Fig. 1(d) shows the sectional shape of a cylinder. In these figures, reference numeral 21 denotes a cylinder made of glass having openings 44 and 45. The tip of the one opening 44 is a hook-shaped tip 22 whose section is bent in a hook shape. Reference numeral 23 denotes a rear end portion of the cylinder; 24 a swelling portion; and 25 a piston. The swelling portion 24 swells at a portion of the circumference of the cylinder as shown in Fig. 24 (d), and forms a communicating path 24' inside it.

In the neighborhood of the center within the cylinder 21, a partition stopper 26 is fit. Both piston 25 and partition stopper 26 are made of flexible resin inclusive of rubber and have lips formed on their outer periphery. The left end of the cylinder 21 in these figures is watertightly closed by an end partition 27. Thus, within the cylinder 21 are formed a vacant chamber 28 between the piston 25 and the partition stopper 26 and another vacant chamber 29 between the end partition 27 and the partition stopper 26. A syringe needle connection portion 30 is fit in the end partition 27, and a cap 31 is fit over the needle connection portion 30.

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Figs. 2 to 3 are views explaining the details of the end partition 27, the needle connection portion 30 and the cap 31. The end partition 27 is made of rubber or resin having elasticity slightly lower than that of the piston 25 and the partition stopper 26, and is formed in a cylindrical-rod-shape with a U-groove 27a formed on the side of the rear end (near the partition stopper). On the bottom of the U-groove 27a are formed several pores 27b. These several pores 27b, which are made radially towards the center axis of the cylinder, constitute plural passages 27b. On the front surface (on the side of the syringe needle) of the end partition 27, crossed-grooves 27c serving as fitting grooves are formed, and at the center of the crossed shape, an opening 27d is formed along the center axis of the cylinder whose tip is communicated with the above passages 27b. The elastic end partition 27 is intimately fit on the side of the opening 44 of the glass rigid cylinder 21 with no gap.

Incidentally, as shown in Figs. 4 to 6, on the rear surface of an end partition 27', crossed grooves 27b serving as passages may be formed which are communicated with the central opening 27d. In such a configuration, the grooves 27b can be easily formed. In this case, in Fig. 1, the partition stopper 26

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abuts on the rear surface of the end partition 27' so that the medicine solution is introduced from the passage 24' of the swelling portion 24 into the grooves 27b. The grooves 27b may be formed radially from the central opening 27d as shown in Fig. 6(a).

In Fig. 2, the syringe needle connection portion 30 integrally includes a crossed frame 30a serving as whirl-stop protrusions fit in the crossed grooves 27c, a parallel cylinder 30b extending rightwards from the center of the crossed frame 30a in the figure and a tapered cylinder 30c extended leftwards from the center of the crossed frame 30a, and is made of a rigid body formed by injection molding of plastic. The tapered cylinder 30c is to be connected to the syringe needle. The openings of the cylinders penetrate from the left end of the cylinder 30c to the right end of the cylinder 30b so as to constitute a passage 30d. The cap 31 is made of flexible rubber or others so as to fit over surely the tapered cylinder 30c and has a shape with a bottomed tapered hole.

As shown in Figs. 4 and 5, plural twisting pieces 31a may be protruded from the outer periphery of cap 31. The twisting pieces 31a permit the cap 31 to be tightly fit over the syringe needle connection portion 30. This enhances the sealing property and

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permits easy removal. The cap 31 is adapted to have a length that its rear end abuts on the crossed frame 30a of the syringe needle connection portion 30 as shown in Fig. 11, and contributes to improve the sealing property together with the twisting pieces 31a.

With reference to Fig. 1, an explanation will be given of the operation of the syringe 46. The syringe 46, as shown in Fig. 1(a), is preserved in a state where the vacant chamber 28 is filled with injection medicine and the vacant chamber 29 is filled with no injection medicine. In use, first, the cap 31 is removed and the syringe needle 32 is fit by a lure-locking system. With the syringe needle 32 upwards, when the piston 25 is pushed as shown in Fig. 1(b), the partition stopper 26 is located at the communicating passage 24' of the swelling portion 24. Then, the injection medicine in the chamber 28 moves into the vacant chamber 29. After air in the vacant chamber 29 is exhausted, the syringe needle 32 is caused to pierce a patient. The injection medicine passes from the passages 27b through the passage 30d to reach the syringe needle 32.

Fig. 1(c) shows the state where injection has been finished. The piston 25 is pushed so that the

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end partition 27, partition stopper 26 and the piston 25 are brought into intimate contact with one another. Then, if the tip (on the side of the syringe needle) of the piston 25 does not reach the interior of the passage 24', the entire injection medicine in the chamber 28 cannot be injected. The passages 27b of the end partition 27 must be located on the passage 24'. In order to satisfy such a condition , the thicknesses of the end partition 27, partition 26 and piston 25 in an axial direction and the length and position of the swelling portion 24 are determined.

Figs. 7(a), (b) show another embodiment of the syringe needle connection portion. In this embodiment, a syringe needle connection portion 33 includes a crossed frame 33a, cylinders 33b, 33c and a passage 33d which are those constituting the syringe needle connection portion 30 shown in Figs. 2 and 3, and further includes an external cylinder 33e for protection outside the tapered cylinder 33c. It should be noted that the tapered cylinders 33c and 30c are connected to the syringe needle 32 by the lure locking system.

Figs. 8(a) to 8(c) show an embodiment of a separate type syringe for injecting two injection medicines, i.e., A and B previously put in the

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syringe in a such a fashion of injecting first medicine A and subsequently medicine B. Fig. (a) shows the state where the medicines are preserved; Fig. 8(b) shows the state when injection is started; and Fig. 8(c) shows the state when the injection has been finished.

This embodiment has a configuration in which another partition stopper 34 is inserted between the piston 25 and the partition stopper 26 in the embodiment of Fig. 1 so as to divide the chamber 28 into chambers 28a and 28b. The chambers 28a and 28b are filled with medicines A and B, respectively. At least the chamber 28b is filled with only medicine with no air contained by the vacuum filling system.

With the cap removed from the state of Fig. 8(a), the syringe needle 32 is connected. With the syringe 32 upwards, when the plunger 25 is pushed, the pressure in the chamber 28b increases to push the partition stopper 34. Thus, the pressure in the chamber 28a increases to push the partition stopper 26 into the side of the communicating passage 24 as shown in Fig. 8(b). Then, the injection medicine within the chamber 28b enters the chamber 29 and air goes out from the syringe needle. Having confirmed that the air has been removed, injection is carried out. The injection medicine in the chamber 28a is

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injected into the body of a patient. When the injection agent in the chamber 28a runs out, the partition stoppers 26 and 34 are brought into intimate contact with each other so that both two partitions are located on the communicating passage 24'. The injection medicine within the chamber 28b is injected into the human body through the passage 24'.

Fig. 8(c) shows the state where injection has been finished. In this state, the tip of the piston 25 must be located on the communicating passage 24'. The communicating passages 27b of the end partition 27 must be located in the communicating passage 24'. On the basis of such a condition, the thickness of each partition stopper and the piston and the length and position of the communicating passage 24' are determined.

Figs. 9(a) to 9(c) show an embodiment of a syringe which can preserve two injection medicines in a divisional manner like Fig. 8, and can inject them after having been mixed (or perform "mixing injection"). The syringe according to the embodiment of Fig. 9 is different from that of Fig. 8 in that two swelling portions 24a and 24b are separated from each other. The partitions 26 and 34 are arranged behind the swelling portions 24a and

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24b, respectively. The chamber is divided into two chambers 28a and 28b which are filled with different injection agents.

In use, with the cap 31 removed in the state of Fig. 9(a), the syringe needle 32 is connected. With the syringe 32 upwards, the plunger 25 is pushed. As shown in Fig. 9(b), the partition stopper 34 is located on the communicating passage 24b'. Air within the chamber 28b passes through the communicating passage 24b' to enter the chamber 28a and subsequently the injection agent enters there. The partition stopper 26 also reaches the communicating passage 24a' and air within the chambers 28a and 28b passes through the communicating passage 24a' to leak out slightly from the syringe needle 32. With the entire injection agent within the chamber 28b having moved into the chamber 28a, the syringe is shaken to mix these two injection agents sufficiently. Thereafter, the air within the chamber 28a is expelled from the syringe. An injection is given to a patient. Fig. 9(c) shows the state when injection has been finished. This state, which is the same as that explained in connection with Fig. 8(c), will not explained here.

Fig. 10 shows an embodiment of the cylinder 21 having a different shape. This cylinder 21 does not

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have the hook-shaped tip portion 22 at the opening 44 on the side of the syringe needle, but a straight opening end whose opening diameter is equal to the inner diameter of the cylinder 21. Such a configuration permits the cylinder to be easily fabricated, thus reducing production cost of the cylinder. Where there is the hook-shaped tip portion 22, the end partition 27 is fit from the opening on the side into which the piston 25 is inserted. But the straight shape as shown in Fig. 10 permits the end partition 27 to be directly fit from the opening 44 on the side of the syringe needle, which can be easily implemented. Fig. 11 shows the sate where the end partition 27' and the cap 31 equipped with the twisting pieces 31a have been mounted in the cylinder 21.

In accordance with the first embodiment, since the elastic engagement between the cylinder made of glass and the end partition made of rubber eliminates the gap therebetween, invasion of flowing steam into the cylinder in the sterilization process can be prevented and invasion of bacteria can be also prevented.

Embodiment 2

Fig. 12 shows the second embodiment of a syringe according to the present invention.

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A syringe 101 according to this embodiment is characterized in that it includes two partition stoppers 103 and 104 made of rubber arranged within a cylinder 102 and the intermediate partition stopper 104 is provided with communicating grooves 108 which communicate circular peripheral grooves 105_1, 105_2 with a first medicine solution 106. The peripheral grooves 105_1 and 105_2 are filled with the first medicine solution 106 from the communicating grooves 108.

Specifically, the intermediate partition stopper 4, as shown in Figs. 13 and 14, has the two peripheral grooves 105_1 and 105_2 between three circular lips 109_1 – 109_3. Plural (six in the example shown) communicating grooves 108 are formed on the circular lip 109_1 on the one side and the intermediate circular lip 109_2 are formed, respectively. The communicating grooves 108 are formed slightly obliquely in a direction of thickness of the partition stopper 104 (axial direction), and have square sectional shapes. The circular lip 109_3 on the other side of the partition stopper 104 is formed to have a diameter equal to those of the circular lip 109_1 and the intermediate circular lip 109_2, but has no communicating grooves. The outer peripheral surface of the circular lips 109_1 to 109_3

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and the bottom surface of the peripheral grooves 105_1 and 105_2 have a semicircular shape (R-shape) as shown in Fig. 13. The peripheral grooves 105_1 and 105_2 serve to decrease the sliding resistance of the partition stopper 104 for the cylinder 102 as explained in connection with the prior art.

In this embodiment, the number of the circular lips 109_1 to 109_3 is three, but may be greater than three. Otherwise, a configuration having two circular lips and one peripheral groove therebetween may be proposed. In this case, the one circular lip has the same communicating groove as described above. Further, the communicating groove 108 may be formed not obliquely but straight in the direction of thickness of the partition stopper 104. The outer peripheral surface of the circular lips 109_1 to 109_3 and the bottom surface of the peripheral grooves 105_1 and 105_2 may have not a semicircular shape (R-shape) as shown in Fig. 13, but may be flat. In place of the communicating grooves 108, communicating holes which communicate the medicine solution 106 with the peripheral grooves 105_1 and 105_2 may be formed in the circular lips 109_1 and 109_2 or the trunk 110 of the intermediate stopper 104.

The intermediate partition stopper 104 is built in the cylinder 102 together with a front partition

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stopper 103 as shown in Fig. 12 by the vacuum filling/stopping technique as in the prior art. In this case, the peripheral grooves 105_1 and 105_2 are filled with the first medicine solution 106 through the communicating grooves 108 and air within the peripheral grooves 105_1 and 105_2 is extruded by the medicine solution 106 and externally sacked along the inner wall 115 of the cylinder.

The front partition stopper 103, which is formed to have a diameter and thickness equal to those of the intermediate partition stopper 104, has two peripheral grooves 111_1 and 111_2 like the intermediate partition stopper 104. The piston 112 behind the intermediate partition stopper 104, which is formed to have a larger thickness than that of the intermediate partition stopper 104, has also two peripheral grooves 113. In this embodiment, the front partition stopper 103 and the piston 112 has no communicating grooves unlike the intermediate partition stopper 104. A piston rod 114 is screwed to the piston. The circular lips 109_1 and 109_2 of the intermediate partition stopper 104 divided in a peripheral direction by the communicating grooves 108 are flexible enough to further decrease the sliding resistance.

In Fig. 12, if the intermediate partition

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stopper 104 is inserted (stopped) oppositely, the communicating grooves 108 are located on the side of the piston 112. In this case, in evacuation by the vacuum filling stopping technique, the peripheral grooves 105_1 and 105_2 are filled with the second medicine solution 107 from the communicating grooves 108. The intermediate partition stopper 104 may therefore be inserted oppositely.

At the front portion of the cylinder 102 of synthetic resin, a vacant chamber 116 is formed which can accommodate the front partition stopper 103 and the intermediate partition stopper 104. On the cylinder inner wall 117 of the vacant chamber 116, plural grooves 118 are formed in the longitudinal direction of the cylinder, and on the cylinder bottom wall 119, radiating grooves 121 communicating the grooves 118 with the syringe needle 120 are formed.

When the front partition stopper 103 is moved into the vacant chamber 116 by pushing the piston rod 114, the first medicine solution 106 passes through the grooves 118 and is supplied to the syringe needle 120 from the front of the vacant chamber 116. Further, when the intermediate partition stopper 104 is moved into the vacant chamber 116, the second medicine solution 107 is guided to the syringe needle 120 through the grooves 118 and 121. When both

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partition stoppers 103 and 104 have been completely moved into the vacant chamber 116, i.e., when injection has been finished, the front circular lip 122 of the piston 112 reaches the groove end 118a to stop.

Incidentally, the front portion 102a of the cylinder 102 including the vacant chamber 116 and the grooves 117, 121 may be made as a separate body which is to be connected to the cylinder body including the partition stoppers 103, 104 and piston 112. The cylinder front portion 102a and the cylinder body or the cylinder 102 may be made of either synthetic resin or glass.

The communicating grooves 108 may be formed on the intermediate and rear lips of the front partition stopper 103 or the front and intermediate lips of the piston 112. In this case, the peripheral grooves 111_1 and 111_2 are filled with the medicine solution 106, and the peripheral grooves 113 of the piston 112 is filled with the medicine solution 107. Further, air stagnancy in the cylinder is eliminated and mixing of bacteria in the air can be prevented. Nitrogen gas is sealed in the front vacant chamber 116.

In accordance with the second embodiment of the present invention, since in injection of medicine

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solution, the peripheral grooves of the partition stoppers or piston are filled with the medicine from the communicating portion (communicating grooves), no air is left in the peripheral grooves. For this reason, there is no fear of bacteria in the air invading the cylinder and two kinds of medicine solutions can be successively injected by one shot without pull-out/in of a syringe or ventilation. Thus, pain of a patient being pricked with the syringe needle can be reduced and working burden of a doctor can be relieved.

Embodiment 3

Figs. 15 to 22 show the third embodiment of the syringe according to the present invention.

A syringe 201, as shown in Fig. 15, includes a single cylinder type cylinder 204 of synthetic resin having communicating grooves 203 on a front inner wall 202, two partition stoppers 205, 206 made of rubber and a rear piston 207 slidably arranged within the cylinder 204, two kinds of medicine solutions 208 and 209 filled between the front partition stopper 205 and intermediate stopper 206 and between the intermediate partition stopper 206 and the rear piston 207, respectively, and a tip sealing portion 212 for water-proof and bacteria-proof formed integrally to a tapered protection external cylinder

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211 peripherally formed outside of the cylindrical syringe needle connection portion 210 on the side of the syringe tip.

The cylinder 204 is integrally molded of amorphous polyolefin (available as ZEONEX from Nihon Zeon Co. Ltd.). As shown in Fig. 16, on the inner wall of the front chamber 213, the above communicating grooves 203 are formed which includes four grooves 203a in a longitudinal direction and radiating grooves 203b which communicate the grooves 203a to a discharging hole 215 of the syringe needle connection portion 210. These communicating grooves 203 can be integrally formed in cylinder molding.

The amorphous polyolefin is generally excellent in gas-barrier property, absorbability (protein), dissolvability (chemical resistance), slidability (rubber stopper), and has most important features of moldablity, burnablity, light-weight and low cost, etc. Since it can be molded freely, grooves which cannot be formed using glass can be formed on the inner wall. Further, since the syringe is burnable, it can be disposed without producing industrial waste.

The front partition stopper 205 moves into the front space 213 by pushing the piston 207 so that the first medicine solution is discharged through the

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communicating grooves 203. Next, the intermediate partition stopper 206 moves into the front space 213 so that the second medicine solution 209 is similarly discharged. Thus, two kinds of medicine solutions can be injected by one shot. Although such a double separate-injection type structure is known in the conventional barrel-equipped syringe, this embodiment is characterized in that the communicating grooves 203 are formed in the integral single-cylinder type resin cylinder 204.

The cylinder 204 made of amorphous polyolefin has elasticity peculiar to synthetic resin and a mirror face like glass. This permits the syringe needle to be lure-locked with the syringe needle connection 210 and also permits the sliding valve and the piston to be slid with low friction. Since the cylinder 204 which is an integral type does not require the barrel to be mounted unlike before, inconvenience of flowing water invading the cylinder from an opening of the barrel during post-sterilization does not occur. Incidentally, PP (polypropylene) can be used in place of amorphous polyolefin. The cylinder made of these materials has also an advantage of low cost.

The front vacant chamber 213 in the cylinder 204, the discharge hole 215 of the syringe needle

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connection portion 210, the circular space 216 between the needle connection portion 210 and the external cylinder 211 are sealed with nitrogen gas. The nitrogen gas may be sealed at pressure slightly higher than atmospheric pressure. Thus, in unsealing the tip sealing portion 212 to mount a syringe needle in the needle connection portion 210, bacteria in a hospital are intercepted by blowing-out pressure of nitrogen gas so that they will not enter the cylinder 204. Further, the medicine 208 and the front vacant chamber 213 are partitioned by the front partition stopper 205 so that the medicine solution 208 is completely isolated from bacteria.

The tip sealing portion 212, as shown in Figs. 17 and 18, includes: a cylindrical head 217 integrally continuous to the tip of the tapered external cylinder 211 outside the needle connection portion 210 through a circular recess groove 219; a thin twisting plate 218 successive to both sides 217a and the tip 217b of the head 217; and a thicker reinforcement frame 220 formed in the external periphery of the twisting plate 218. The boundary between the external cylinder 211 and the head 217 is formed to have the circular recess groove 219 having a wedge-shaped section and a small thickness. The twisting plate 218 is extended downwardly along the

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external cylinder 211 so that the inside makes a provisional junction (221) with the external cylinder 211 and the lower end makes another provisional junction (222) with a fin-shaped remaining portion 223 rising form the bottom 214 of the cylinder. The provisional junctions 221 and 222 are so adapted as to be easily separated when the twisting plate 218 is rotated. Incidentally, the remaining thickness portions 223 are not necessarily provided and the provisional junctions (221, 222) are not necessarily required.

The structure of the above tip hermetic sealing portion 212 is known as a profile seal system in a medicine solution package. The feature of the hermetic sealing structure according to the present invention resides in that said tip hermetic sealing is continuously formed to the protection external cylinder 211 for protection located outside the needle connection portion 210 so that the needle connection portion 210 is completely sealed and isolated from the outside. The external cylinder 211 is formed so as to protrude slightly higher than the needle connection portion 210 so that the needle connection portion 210 is not brought into contact with the head 217. Nitrogen gas is sealed within the circular space 216 surrounded by the head 217 and the

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external cylinder 211. The needle connection portion 210 is completely isolated from the outside by the head 217 and the external cylinder 211.

The tip hermetical-sealing portion 212 is made in actual fabrication in such a manner that it is attached to the external cylinder 211 by laser welding or ultrasonic-wave welding, or in a manner of double molding, i.e., molding the tip hermetic-sealing portion 212 by a second mold after molding the needle connection portion 210 by a first mold. Preferably, the external cylinder 211 has a diameter tapered toward the tip, and the tip 211a of the external cylinder 211, which has a possibly smaller diameter, is fixed toward the center of the head 217. This permits the twisting plate 218 to be operated by smaller force.

In use, a person engaged in medical treatment takes out the syringe 201 from a sterilization sack and twist the twisting plate 218 by fingers so that the provisional coupling portions 221 and 222 of the twisting 218 are separated and the head 217 rotates simultaneously with the twisting plate 218 so that it is separated from the tip 211a of the external cylinder 211. Thus, as shown in Fig. 18(b), the tip 211a of the external cylinder 211 is cut flatly (horizontally) to form a circular opening 224 at the

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tip 211a of the external cylinder 211. Even if bacteria in a hospital intend to invade the cylinder 204 simultaneously when the opening 224 is formed, the pressure of the nitrogen gas filled in the front vacant chamber 213 and discharging hole 215 stops invasion of the bacteria. Subsequently, the syringe needle 225 in a separate sack is firmly fixed to the needle mounting (connection) portion 210 by lure-locking.

Fig. 19 shows a first modification of the hermetic-sealing structure of the above syringe.

In this hermetic-sealing structure, a spherical head 227 is fixed, through a circular recess groove 226, to the tip of the external cylinder 211 outside the needle connection portion 210 of the cylinder 204 made of synthetic resin as in the above case, and a thick twisting plate 228 is provided to extend from the round head 227, thus completing a tip hermetic-sealing portion 229. This example is characterized in that the spherical head 227 is fixed to the tip of the tapered external cylinder 211 outside the needle connection portion 210 to seal the needle connection portion 210 on the inside of the external cylinder 211 completely. By twisting the twisting plate 228, the spherical head 227 is separated from the external cylinder 211 at the circular recess groove 226 so

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that the syringe needle 210 appears in the external cylinder 211.

Figs. 20 to 21 show a second modification of the hermetic-sealing structure of the kit-style syringe.

In this hermetic-sealing structure, a disk-shaped head 230 is connected to the tapered external cylinder 211 outside the needle connection portion 210 made of synthetic resin as in the above example, and a twisting plate 231 is protruded at the center of the disk-shaped head 230, thus completing a tip hermetic-sealing portion 234. The disk-shaped head 230 and the external cylinder 211 are connected integrally to each other through a circular recess groove 232 having a wedge section on the outside, and the flat twisting plate 231 is extended from the disk-shaped head 230. A pair of protruding plates 233 are integrated to the twisting plate 231. By twisting the protruding plates 233, the disk-shaped head 230 is cut along the circular recess groove 232 so as to be separated from the external cylinder 211. Thus, such a state results in that a syringe needle can be mounted in the needle mounting portion 210 in the external cylinder 211.

Fig. 22 shows a syringe with the tip hermetic-sealing portion 234. In this syringe 235, a communicating groove 238 as explained in the

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embodiment of Fig. 13 is formed in a front vacant chamber 237 of a cylinder 236 made of the amorphous polyolefin or resin such as PP, and an intermediate communicating groove 239 in a longitudinal direction is formed at the intermediate portion of the inner wall of the cylinder. A diluted solution 243 is accommodated between an intermediate partition stopper 241 behind the intermediate communicating groove 239 and a piston 242. Medicine powder is accommodated between the intermediate partition stopper 241 and the front partition stopper 240. Since the cylinder 236 is integrally molded using resin, the intermediate communicating groove 239 does not swell externally unlike the conventional cylinder made of glass. The cylinder itself has a smart design.

The nitrogen gas sealed in the front vacant chamber 237 of the cylinder 236 stops invasion of bacteria into the cylinder 236 together with the front partition stopper 240 when the tip sealing portion 234 is unsealed. In the syringe 235, when the piston 242 is pushed, the intermediate partition stopper 241 is located at the communicating groove 239, and the diluted solution 243 enters the intermediate chamber 245 through the intermediate communicating groove 239 to solve medicine powder

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244. When the piston 242 is further pushed, the front partition stopper 240 is located on the communicating groove 238 so that the medicine solution is introduced into the discharge hole 246 through the communicating groove 238.

Each of the hermetic-sealing structure described above can be applied to not only a double layer type syringe with two partitions but also a single layer syringe using a single partition stopper, a syringe with no partition stopper but only a stopper or the conventional syringe with a barrel. In these cases, a configuration is desired whose front chamber is sealed with nitrogen gas and which has a front partition stopper.

In the third embodiments described above, the syringe needle connection portion is surrounded by the external cylinder and the tip hermetic-sealing portion so that it is completely sealed. For this reason, in post-sterilization or safe-keeping, no water drops or bacteria is mixed into the cylinder, but complete sanitization of the kit style syringe can be attained. In using the syringe, the twisting plate can be twisted to unseal the tip hermetic-sealing portion. Persons engaged in medical treatment is subjected to no burden. Further, in unsealing, the gas pressure in the cylinder and the

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front partition stopper stops invasion of bacteria from the syringe needle connection portion. Complete sanitization in using the syringe is attained. In addition, the resin integral cylinder can solve invasion of flowing vapor or bacteria from the cylinder intermediate portion as in the conventional barrel style syringe. The resin integral cylinder, which is combustible and inexpensive, can be disposed. Since it is not used again, it is very sanitary. Further, since disinfection is not required, burden for persons engaged in medical treatment can be reduced.

[Industrial Applicability]

As described above, in accordance with the first embodiment of the present invention, since the member equipped with the connection needle connection portion can be intimately coupled with the cylinder, invasion of bacteria from the junction between the member and cylinder can be prevented during safekeeping for a long time. In accordance with the second embodiment, since in injection of medicine solution, the medicine solution is filled in the peripheral grooves of the partition stopper and/or the piston through the communicating portion (communicating grooves), air does not remain in the

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peripheral grooves so that there is no fear of vacteria invading the cylinder. Further, in accordance with the third embodiment, since the syringe needle connection portion is completely hermetically sealed, water drops or vacteria will not be mixed into the cylinder from the syringe needle connection portion in sterilization using flowing vapor or safekeeping for a long time. The resin integral style cylinder solves the problem of invasion of vacteria water drops from the conventional cylinder intermediate portion and complete hermetic-sealing assures a very sanitary state. Further, in unsealing the syringe needle connection portion, the gas sealed in the cylinder and the front partition stopper commonly stop invasion of vacteria from the syringe needle connection portion so that in using the syringe, complete sanitization can be realized. In addition, since the resin integral style cylinder, which is combustible, can be disposed. Since it is not used again, it is very sanitary and burden for persons engaged in medical treatment is very slight. Accordingly, three rules of the kit style syringe, i.e., reduction in burden, prevention of mixing of alien substance and destruction of vacteria pollution can be realized in preparing medicine.

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Claims

1. A syringe characterized by comprising:

a cylinder having openings on both ends and a communicating passage provided near the one opening in an axial direction and from whose other opening a piston is inserted;

a partition stopper which is slidable within said cylinder and defines a plurality of chambers in said cylinder;

an elastic end partition having a passage in a radial direction fit on the one opening side of said cylinder and guided to said communicating passage and another passage in an axial direction communicating with said passage; and

a rigid syringe connection portion fit in said passage in an axial direction of said end partition.

2. A syringe according to claim 1, characterized in that said syringe needle connection portion has whirl-stop protrusions in a radial direction and said end partition has fitting grooves corresponding to said whirl-stop protrusions.

3. In a syringe in which medicine solution is filled between a partition stopper and a rear piston arranged slidably in a cylinder, and in the outer



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periphery of said partition stopper, a plurality of circular lips and a peripheral groove between said plurality of lips are formed, said syringe characterized in that a communicating portion communicating said medicine solution with said peripheral groove is formed.

4. A syringe according to claim 3, characterized in that said peripheral grooves are formed in said rear piston and a communicating portion communicating said grooves with said medicine is formed in said rear piston.

5. A syringe according to claim 3 or 4, characterized in that said communicating portion is a communicating groove formed in said circular lip of said partition stopper or said rear piston.

6. In a syringe including a syringe needle connection portion and an external cylinder for protection outside said syringe needle connection portion which are formed at the tip of a cylinder made of synthetic resin, said syringe characterized in that a tip hermetic-sealing portion for hermetically sealing said syringe needle connection portion in said external cylinder is integrally



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formed at the tip of said external cylinder.

7. A syringe according to claim 6, characterized in that said tip hermetic-sealing portion includes a head fixed at the tip of said external cylinder through a circular recess groove, and at twisting plate extended from said head.

8. A syringe according to claim 6 or 7, characterized in that said cylinder is a resin-integral type cylinder in which said partition stopper and said rear piston are slidable, and a communicating groove for introducing medicine solution successive to a discharge hole of a syringe needle mounting portion is formed in a front vacant chamber of said cylinder.

9. A syringe according to claim 8 characterized in that said front vacant chamber partitioned by said partition stopper is sealed with gas.

10. A syringe according to claim 8, characterized in that the material of said cylinder is made of amorphous polyolefin and others.



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