

Syringe Cover Device

Technical Field

The present invention relates to medical devices and in particular, the present
5 invention relates to a device for covering a back opening of a syringe and a syringe
incorporating such a device.

Background

10 Hazardous drug exposures to presently known syringes in medical applications
may lead to serious health complications from skin irritation to birth defects and even
carcinogenic, genetic and mutational consequences.

While there are already devices that provide containment of the volatile organic
15 contaminants when the syringe is connected and disconnected, there is an absence of
means to control the exposures arising from the contaminated inner surface of the syringe
barrel after the contents of the syringe is expelled. The disposal of syringes with its
plunger pushed forward and the inner surface of the barrel exposed presents a problematic
source of hazardous drug contamination.

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Summary

The present invention provides a solution to reducing exposure of hazardous drugs
resulting from its transfer from a vial to a syringe and then from the syringe to an IV
25 infusion bag.

According to one aspect, the present invention provides a cover device to attach to
a syringe that seals the inner walls of the syringe barrel at the back opening of the syringe.
According to another aspect, the present invention provides a syringe with a cover device
30 attached to the syringe barrel flange and seals the back end of the syringe barrel.
The syringe cover device is configured to fit the flange and syringe diameter of most
commonly available syringes, in either a detachable or non-detachable manner.

The benefit of the invention is that the user could decide on the appropriateness of installing the syringe cover to a standard syringe based on the contents that the syringe would be used to withdraw and expel unlike the use of expensive syringe with similar or equivalent features. The present invention offers a more cost-effective solution that is appropriate with the actual use situation.

The syringe cover device would be attached by the user and disposed with the syringe after use. In other embodiments, the present invention provides a syringe with a syringe cover device attached thereto, which is provided as a ready to use syringe with a closed barrel cover device.

According to one embodiment, a syringe cover device comprises a first cap with a first frame and a first seal coupled thereto, and a second cap with a second frame and a second seal coupled thereto. The first frame and the second frame are couplable to each other to form an accommodating space therebetween. The first seal and the second seal are couplable to each other to form a main seal body and disposed in the accommodating space. The main seal body has a first surface abutting against the first frame and the second frame, a second surface opposite to the first surface and an aperture formed through the first surface and the second surface. The first frame and the second frame may be attached to a syringe flange with the syringe plunger passing through the aperture to cover and seal a back opening of the syringe barrel.

The first frame 320 and the second frame 380 each has a respective first stopper 320a and a second stopper 380a extending towards the accommodating space, the first surface of the main seal body abutting against the first stopper and the second stopper. Upon the first frame 320 and the second frame 380 being secured to a syringe 200, the first seal 340 and the second seal 360 clamp a plunger strut 38 of the syringe 200 therebetween such that the plunger strut 38 movably passes through the aperture 354, and the second surface of the main seal body 352 is brought into abutment against a flange 98 of the syringe 200 to cover a back opening 93 of the syringe 200.

The aperture 354 has four slits 345, 355a, 355b, 365 evenly distributed in a polar array about a longitudinal axis 300a, each slit extending in a radial direction 3001/2/3/4r perpendicular to the longitudinal axis 300a, the first frame 320 having a first retaining arm 324 coupled thereto and the second frame 380 having a second retaining arm 384 coupled thereto, wherein the first retaining arm 324 and the second remaining arm 384 are distributed symmetrical about the longitudinal axis 300a and spaced apart from each other with an arm distance therebetween greater than a first width of the flange and .

The first frame and the second frame are attachable to the flange between a first annular position and a second annular position, upon being at the first annular position, the first retaining arm 324 abuts against a first finger-hold portion 98a of the flange 98 and the second retaining arm abuts against an opposite second finger-hold 98b portion of the flange and upon being at the second annular position, the first retaining arm abuts against the second finger-hold portion of the flange and the second retaining arm abuts against the first finger-hold portion of the flange.

The main seal body 352 has a first fin 3402, 3602 formed on the first surface 352a and at a periphery of the aperture, and a second fin 3408, 3608 formed on the second surface 352b and at a periphery of the aperture 354, wherein upon the first frame 320 and the second frame 380 being secured to the syringe 200, the first fin and the second fin bias against the plunger strut to form a plunger sealing interface.

The main seal body having an annular ridge 359 to abut against the flange 98 of the syringe 200 to form a flange sealing interface, wherein the plunger sealing interface and the flange sealing interface seal the back opening of the syringe to prevent liquid communication therethrough.

The flange sealing interface and the second flange sealing interface are oriented orthogonal to each other.

The first seal 340 and the second seal 360 each has a pair of radial recesses 343, 363 and the first frame and the second frame each has a pair of radial projections 323, 383 each of which being received in a respective radial recess.

5 The syringe cover device further comprises an orifice 326 passing through the first frame 320, wherein the orifice establishes air communication between an inner space of the barrel and an outer space of the barrel.

10 The syringe cover device further comprises an air filter 390 covering the orifice 326.

15 The syringe cover device further comprises a first support arm extending radially from the first frame 320 and a second support arm extending radially from the second frame 380, a hinge pin 328 projecting axially from the first support arm and a hinge bearing 388 formed on the second support arm, wherein the hinge pin is rotatably received in the hinge bearing to enable relative movement between the first frame 320 and the second frame 380 relative to each other.

20 The hinge bearing includes an elongated groove about which the hinge pin is rotatable and along which the hinge pin is slidable to vary a positional relationship between the first frame and the second frame.

25 The syringe cover device further comprises a lock arm 329 coupled to the first frame 320 and a lock catch 389 coupled to the second frame 380, wherein upon the first frame and the second frame being coupled to each other the lock arm is engaged with the lock catch to secure the first frame and the second frame to each other.

30 According to another aspect, the present invention provides a syringe which comprises a barrel and a plunger movably disposed in the barrel, and a cover device attached to the barrel and the plunger. The barrel has a front opening, a back opening and a flange formed at the back opening. The plunger has a plunger strut passing through the back opening and the flange. The cover device caps the back opening of the barrel. The

cover device has an aperture through which the plunger strut movably passes, and an end surface abutting against the flange of the barrel. The aperture and the plunger strut form a first seal interface to the back opening, and the end surface of the cap and the flange form a second seal interface to the back opening.

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The cover device comprises:

a first cap 50 having a first frame 320 and a first seal 340 coupled to the first frame 320;

10 a second cap 70 having a second frame 380 and a second seal 360 coupled to the second frame 380;

the first frame 320 and the second frame 380 being coupled to each other to form an accommodating space 350 therebetween;

15 the first seal 340 and the second seal 360 being coupled to each other to form a main seal body 352 and disposed in the accommodating space 350, the main seal body 352 having a first surface 352a abutting against the first frame and the second frame, a second surface 352b opposite to the first surface

wherein the aperture 354 is formed through the first surface and the second surface.

20 The first frame 320 and the second frame 380 each having a respective first stopper 320a and 380a extending towards the accommodating space, the first surface of the main seal body abutting against the first stopper and the second stopper. Upon the first frame 320 and the second frame 380 being secured to a syringe 200, the first seal 340 and the second seal 360 clamp a plunger strut 30 of the syringe 200 therebetween such that the
25 plunger strut 30 movably passes through the aperture 354, and the second surface of the main seal body 352 is brought into abutment against a flange 98 of the syringe 200 to cover a back opening 93 of the syringe 200.

30 The aperture 354 has four slits 345, 355a, 355b, 365 evenly distributed in a polar array about a longitudinal axis 300a, each slit extending in a radial direction 300r perpendicular to the longitudinal axis 300a, the first frame 320 having a first retaining arm 324 coupled thereto and the second frame 380 having a second retaining arm 384 coupled

thereto, wherein the first retaining arm 325 and the second retaining arm 384 are distributed symmetrical about the longitudinal axis 300a and spaced apart from each other with an arm distance therebetween greater than a first width of the flange.

5 The first frame and the second frame are rotatable relative to the syringe flange about the longitudinal axis between a first position at which the first retaining arm 324 abuts against a first finger-hold portion 98a of the flange 98 and the second retaining arm abuts against a second finger-hold portion 98b of the flange, and a second position at which the first retaining arm abuts against the second finger-hold portion of the flange and
10 the second retaining arm abuts against the first finger-hold portion of the flange.

 The main seal body 352 has a first fin 3402, 3602 formed on the first surface 352a and at a periphery of the aperture, and a second fin 3408, 3608 formed on the second surface 352b and at a periphery of the aperture 354, wherein upon the first frame 320 and
15 the second frame 380 being secured to the syringe 200, the first fin and the second fin bias against side surfaces of the plunger strut to form a plunger sealing interface.

 The main seal body having an annular ridge 359 to abut against the flange 98 of the syringe 200 to form a flange sealing interface, wherein the plunger sealing interface
20 and the flange sealing interface seal the back opening of the syringe to prevent liquid communication therethrough.

 The flange sealing interface and the second flange sealing interface are oriented orthogonal to each other.

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 The first seal 340 and the second seal 360 each has a pair of radial recesses 343, 363 and the first frame and the second frame each has a pair of radial projections 323, 383 each of which being received in a respective radial recess.

30 The syringe further comprises an orifice 326 passing through the first frame 320 to establishes air communication between an inner space of the barrel and an outer space of the barrel.

The cover device further comprises an air filter 390 covering the orifice 326.

The syringe further comprises a first support arm extending radially from the first frame 320 and a second support arm extending radially from the second frame 380, a hinge pin 328 projecting axially from the first support arm and a hinge bearing 388 formed on the second support arm, wherein the hinge pin is rotatably received in the hinge bearing to enable relative movement between the first frame 320 and the second frame 380 relative to each other.

The hinge bearing is an elongated groove about which the hinge pin is rotatable and along which the hinge pin is slidable to vary a positional relationship between the first frame and the second frame.

The syringe of further comprises a lock arm 329 formed on the first frame 320 and a lock catch 389 formed on the second frame 380, wherein upon the first frame and the second frame being coupled to each other the lock arm is engaged with the lock catch to secure the first frame and the second frame to each other.

Brief description of drawings

Fig. 1 is a perspective top view of a syringe cover device according to one embodiment of the present invention;

Fig. 2 is a perspective bottom view of Fig. 1;

Fig. 3 is a partial exploded view of Fig. 1;

Fig. 4 is a perspective top view showing the syringe cover device of Fig. 1 at disassembled status;

Fig. 5 is a perspective bottom view of Fig. 4;

Fig. 6 is a perspective view showing the syringe cover device of Fig. 1 when attached to syringe;

5 Fig. 7 is an enlarged view of portion 7 of Fig. 6;

Fig. 8 is a partial exploded view of Fig. 6;

Fig. 9 is a side view of Fig. 6;

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Fig. 10 is a cross-sectional bottom view of Fig. 9 along A-A;

Fig. 11 is a partial cross sectional view of Fig. 6 along B-B;

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Fig. 12 is a partial cross sectional view of Fig. 6 along C-C;

Fig. 13 is an enlarged view of portion 13 of Fig. 11;

Fig. 14 is an enlarged view of portion 14 of Fig. 12;

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Fig. 15 is a partial exploded view of Fig. 12;

Fig. 16 is a partial enlarged view of portion 16 of Fig. 15;

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Fig. 17 is an enlarged side view of portion 16 of Fig. 15;

Fig. 18 is a partial exploded top view of Fig. 6;

30 Figs. 19A, 19B, 19C and 19D are perspective views showing a method of attaching a syringe cover device of Fig. 1 to a syringe;

Detailed description of the invention

As shown in Fig. 1 to Fig. 5, according to one embodiment, a syringe cover device 300 includes a first cap 50 and a second cap 70, in the form of for example a first semi disc 50 and a second semi disc 70 of a complementary structure, respectively. The first cap 50 includes a first frame 320 of a semicircle shape and a first seal 340 coupled to a concave side of the first frame 320. The second semi disc 70 includes a second frame 380 of a semicircle shape and a second seal 360 coupled to a concave side of the second frame 380. The first cap 50 and the second 70 are movable relative to each other in its main plane around its hinge-like joint which is formed by a hinge pin 328 formed on the first frame 320, and a hinge bearing 388 formed on the second frame 380. When the first cap 50 and the second cap 70 are positioned with its diameter adjacent and aligned to each other, the resultant structure is a full-disc-shaped cover device which approximately corresponds in size and shape to the open back end of a syringe barrel 90.

In the embodiment as illustrated therein, the first frame 320 and the second frame 380 are couplable to each other, to form an accommodating space 350 between the first frame 320 and the second frame 380. The first and second seals 340, 360 are couplable to each other to form a main seal body 352, and the main seal body 352 is disposed in the accommodating space 350 surrounded by the first and second frames 320, 380. The main seal body 352 has a first surface 352a, a second surface 352b opposite to the first surface and an aperture 354. The aperture 354 is formed through the first surface 352a and the second surface 352b.

The first frame 320 has a first stopper 320a. The second frame 380 has a second stopper 380a. The first stopper 320a and the second stopper 380a are located at or adjacent to the first surface 352a, and extend towards the accommodating space 350. The first surface 352a of the main seal body 352 abut against the first stopper 320a and the second stopper 380.

As shown in Fig. 6 to Fig. 10, a syringe 200 includes a barrel 90 and a plunger 30 movably disposed in the barrel 90. The barrel 90 has a front opening 91, a back opening 93 and a flange 98 formed at the back opening 93. The plunger 30 has a plunger strut 38

passing through the back opening 93 and the flange 98. The first seal 340 and the second seal 360 made of soft pliable material enclosed within the first and second frames 320, 380 act as seals 340, 360 that encloses the volume space formed by the inner walls of the barrel 90 and the strut 38 of the plunger 30.

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Upon the first frame 320 and the second frame 380 being secured to syringe 200, the first seal 340 and the second seal 360 clamp the plunger strut 38 of the syringe 200 therebetween such that the plunger strut 38 movably passes through the aperture 354. The second surface 352b of the main seal body 352 is brought into abutment against the flange
10 98 of the syringe barrel 90. With the first frame 320, the second frame 380, the first seal 340 and the second seal 360 coupled to the syringe 200 in the above-illustrated manner, the first seal 340 and the second seal 360 forms the main seal body 352 to cover the back opening 93 of the syringe 200.

15 The first and second seals 340, 360 are formed by any soft, pliable material suitable for use as air-tight and liquid-tight seals for a syringe. For example, the first and second seals 340, 360 are formed of thermoplastic elastomer, silicone, rubber, isoprene or the like. The first frame 320 and the second frame 380 are formed of material suitable to provide necessary structural strength to support and secure the first and second seals 340,
20 360 to the syringe 200. The first frame 320 and the second frame 380 are formed of materials with structural strength and rigidity higher than the material of the first and second seals 340, 360. The first seal 340, second seal 360, first frame 320 and second frame 380 may be formed individually by e.g. over mold injection process or 3D printing, and assembled together by coupling the first seal 340 to the concave side of the first frame
25 320 to form the first cap 50 which is an assembled component, and by coupling the second seal 360 to the concave side of the second frame 380 to form the second cap 70 which is also an assembled component. Alternatively, the rigid first frame 320 and second frame 380 are firstly made of a first material by e.g. inject molding, and followed by injecting a second material that forms the area defined by the first frame 320 and the second frame
30 380. The firstly formed first and second frames 320, 380 retain the soft, pliable material that forms the first and second seals 340, 360 to form the integral first cap 50 and second cap 70. Accordingly, the first seal 340 may be formed to the concave side with the first

frame 320 by insert-molding process, such that the first seal 340 and the first frame 320 form the first cap 50 which is an integral component. Likewise, the second seal 360 may be formed to the concave side with the second frame 380 by insert-molding process, such that the second seal 360 and the second frame 380 form the second cap 70 which is also an integral component.

As shown in Fig. 3 and Fig. 4, the first seal 340 has a first slit 345 and a pair of first recesses 340a, 340b formed thereon. The first slit 345 and each of the pair of first recesses 340a, 340b have a same length, and each of the pair of first recesses 340a, 340b has a width which is half of the width of the first slit 345. Likewise, the second seal 360 has a second slit 365 and a pair of second recesses 360a, 360b formed thereon. The second slit 365 and each of the pair of second recesses 360a, 360b have a same length as the first slit 345 and the pair of first recesses 340a, 340b. The second slit 365 has the same width as the first slit 345. Each of the pair of second recesses 360a, 360b has a width which is half the width of the second slit 365.

The first seal 340 and the second seal 360 form the main seal body 352 and with the aperture 354 formed passing through the main seal body 352. The aperture 352 therefore has four aperture slits 345, 355a, 355b and 365, in which, aperture slit 355a is formed by one of the pair of first recess i.e. first recess 340a and one of the pair of second recess i.e. second recess 360a joining the first recess 340a. The aperture slit 355b is formed by the other one of the pair of first recesses, i.e. first recess 340b and the other one of the second recesses i.e. second recess 360b joining the first recess 340b. Accordingly, the aperture 354 has four slits / recesses 345, 355a, 355b and 365 formed on respective first and second seals 340, 360 which joint to each other to form the main seal body 352.

As shown in Fig. 1, Fig. 2, Fig. 3 and Fig. 10, the four slits 345, 355a, 355b, 365 are evenly distributed in a polar array about a longitudinal axis 300a. Each slit 345, 355a, 355b, 365 extends in a respective radial direction 3001r, 3002r, 3003r and 3004r perpendicular to the longitudinal axis 300a. The first frame 320 has a first retaining arm 324 coupled thereto. The second frame 380 has a second retaining arm 384 coupled thereto. The first retaining arm 324 and the second remaining arm 384 are spaced apart

from each other in opposite radial directions and symmetrical with respect to the longitudinal axis 300a, for example in respective second radial direction 3002r and 3004r, and with an arm distance D11 between the first retaining arm 324 and the second retaining arm 384 greater than a first width W11 of the flange 98.

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The first frame 320 and second frame 340 are attachable to the flange 98 between a first annular position P11 and a second annular position P12 which is 90 degrees away from the first annular position P11 with respect to the longitudinal axis 300a. At the first position P11, the first retaining arm 324 abuts against a first finger-hold portion 98a of the flange 98 and the second retaining arm 384 abuts against a second finger-hold portion 98b of the flange 98 positioned opposite to the first finger-hold portion 98a. At the second position P12, the first retaining arm 324 abuts against the second finger-hold 98b portion of the flange 98, and the second retaining arm 384 abuts against the first finger-hold portion 98a of the flange 98.

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As shown in Fig. 11 to Fig. 17, the main seal body 352 has a first fin 3402, 3602 formed on the first surface 352a and at a periphery of the aperture 354, and a second fin 3408, 3608 formed on the second surface 352b and at a periphery of the aperture 354. Upon the first frame 320 and the second frame 380 being secured to the syringe 200, the first fin 3402, 3602 and the second fin 3408, 3608 bias against the fins of the plunger strut 38, e.g. fin 305a as shown in Fig. 16, to form a plunger sealing interface 309.

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The main seal body 352 has an annular ridge 359 formed by the first half ridge 349 of the first seal 340 and the second half ridge 369 of the second seal 360, to abut against the flange 98 of the syringe 200 to form a flange sealing interface 989. The first seal 340 and second seal 360 together with the plunger sealing interface 309 and the flange sealing interface 989 prevent liquid communication between an inner space and an outer space of the barrel 90 through the back opening 93.

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The plunger sealing interface 309 and the flange sealing interface 989 are oriented orthogonal to each other, as shown in Fig. 16 by respective normal direction 309n of the plunger sealing interface 309 and 989n of the flange sealing interface 989.

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As shown in Fig. 15, the first seal 340 has a pair of first radial recesses 343. The second seal 360 has a pair of second radial recesses 363. The first frame 320 has a pair of first radial projections 323, and the second frame 380 has a pair of second radial
5 projections 383. The pair of first radial projections 323 are received and embedded in the pair of first radial recesses 343. The pair of second radial projections 383 are received and embedded in the pair of second radial recess 363. Positioned in the above-illustrated manner, the first and second frames 320, 380 provide stable and reliable structural support at the center portion of the first seal 340 and the second seal 360, to secure and maintain
10 the first and second seals 340 and 360 to the syringe flange 98 and plunger strut 38.

The cover device 300 may include an orifice 326 formed on the first frame 320. The orifice 326 establishes air communication between an inner space of the barrel 90 and an outer space of the barrel 90, to ease the operation of pushing / pulling of the plunger 30
15 into / from the syringe barrel 90. The cover device 300 may further include a filter 390 covering the orifice 326. Filter 390 may be made of materials that allows air to pass through but prevent liquid and solid contents from passing through. Filter 390 prevents contaminants from leaking through the orifice 326 or entering the barrel 90 via the back opening 93 during operation of the syringe 200 when the plunger 30 is pulled or pushed.

The syringe cover device 300 may include a hinge pin 328 projecting axially from the first frame 320 and a hinge bearing 388 formed in the second frame 380. The hinge pin 328 is rotatably received in the hinge bearing 388 to form a hinge 358. Hinge 358 allows relative movement between the first frame 320 and the second frame 380 about the
25 hinge 358. The hinge bearing 388 includes an elongated groove 388a. The hinge pin 328 is rotatable in the groove 388a and independently or concurrently, the hinge pin 328 is slidable along the groove 388a to vary a positional relationship between the first frame 320 and the second frame 380.

The syringe cover device 300 may include a lock arm 329 coupled to or formed integral with the first frame 320, and a lock catch 389 coupled to or formed integral with the second frame 380. Upon the first frame 320 and the second frame 380 being coupled
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to each other and with the syringe flange 90 clamped between the first seal 340 and the second seal 360, the hinge pin 328 is engaged with the hinge bearing 388 and the lock arm 329 is engaged with the lock catch 389, to lock the first frame 320 and the second frame 380 to each other and secure to the first seal 340 and the second seal 360 to cover and seal the back opening 93 of the barrel 90 of the syringe 200.

The aperture 354 has a perimeter rim matching the cross section profile of a syringe plunger strut 38. Upon the first cap 50 and the second cap 70 being attached to a syringe 200, by e.g. the first frame 320 and second frame 380 clamping the strut 38 of the syringe plunger 30 therebetween, the syringe plunger strut 38 is disposed to pass through the aperture 354, and the rim of the aperture 354 is brought into contact with the strut 38 of the plunger 30. Engagement of the rim of the aperture 354 with the strut 38 allows the movement of the syringe plunger 30 relative to the barrel 90 without significant obstruction or resistance, i.e. the frictional force between the slits 345, 355 and 365 of the aperture 354 and the strut 38 of the syringe plunger 30 is negligible from the point of view of a user operating the syringe 200.

The slits 345, 355 and 365 of the seals 340, 360 are formed in a manner which, upon the first seal 340 and the second seal 360 being coupled to each other, form the aperture 354 that accommodate and adapt to the cross section profile and structure of the syringe plunger 30. In particular, the strut 38 and vanes 304, 305a, 305b and 306 structured to reinforce the patency of the plunger 30 in pushing / pulling the contents drawn into / from the syringe barrel 90, are received and in contact with the perimeter rim of the aperture 354.

When a standard syringe is presented to the user, the cross formed at the intersectional of the vanes 304, 305a, 305b and 306 could be in any arbitrary orientation relative to the open end of the syringe barrel 90. The cover device 300 could be easily attached to the open back end 93 of the barrel 90 without the need to manually vary or re-orientate the position of the strut 38 and vanes 304, 305a, 305b and 306 of the plunger 30 along the annular direction of the plunger 30 relative to the barrel 90.

As shown in Fig. 10 with further details, first annular position P11 and second annular position P12 define an annular range R11 of approximately 90-degree angle within which at least one of the vanes 304, 305a, 305b and 306 of the plunger strut 38 is disposed. The situation where two of the vanes e.g. vanes 304 and 306 are disposed at position P1 represent the extreme position at which all the four vanes are oriented respect to the flange 90. When vanes 304 and 306 are disposed at position P1, the first frame 320 and the second frame 380 are able to be clamped to the flange 90 by the first arm 324 and second arm 384 abutting against the respect first and second hand-hole portions 98a and 98b. In the situation where one of the vanes e.g. vane 306 is positioned beyond position P1 i.e. access of vane 306 is hindered by the second hand-hold portion 98b, there will be a neighboring vane i.e. vane 305a disposed within the annular range R11 and is therefore accessible for being received by a slit of one of the first seal 340 and second seal 360, as a start of attaching the syringe cover device to the syringe.

As such., the syringe cover device 300 could be attached to the open end 93 of the barrel 90 of a syringe, regardless of the orientation of the vanes 304, 305a, 305b and 306 on the syringe plunger 30. This is achieved by locating the hinge pin 328 and the hinge bearing 388 that connects the first cap 50 and second cap 70 at a position further away from the edge of the syringe flange 98, so that the circular movement traced by the arms 327, 387 extended from the hinge pin 328 and hinge groove 388 is not obstructed by any part of the syringe. This feature obviates the need to manually align the annular orientation of the syringe plunger 30, such that the slits 345, 355a, 355b and 365 of the first and second seals 340, 360 of the first and second caps 50, 70 could be affixed around the vanes of the plunger 30 and allow the first and second caps 50, 70 to form a complete round disc-shaped cover without being obstructed by the syringe flange 98. In the situation where two of the four diametrically located vanes of the plunger 30 are aligned with and obstructed by the finger-hold 98a, 98b of the syringe flange 98 from inserting into the slits of the first seal 340 and second seal 360, the other two perpendicularly positioned vanes become accessible from the sides of the flange 98 where no finger-hold 98a, 98b is in place, hence such other two vanes can be aligned and inserted into the slits of the first seal 340 and the second seal 360.

To attach the cover device 300 to the open end of the syringe barrel 90, as shown in Figs. 19A to 19D, first cap 50 and second cap 70 are firstly separated by pivoting away from each other about the hinge pin 328 and hinge bearing 388, to expose the slits 345,
5 340a, 340b, 365 360a and 360b. The second seal 70 is further moves away from the first seal 50 by the hinge pin 328 sliding in the hinge bearing 388 , as shown in Fig. 19A, one slit of the soft pliable material seal located in one of the seals 340, 360, e.g. the slit 345 of the first seal 340 disposed in the first frame 320, is slide-fit and affixed around one of the vanes of the syringe plunger strut 38, e.g. vane 304 which is positioned facing away from
10 the finger-hold portions 98a and 98b of the flange 98. In the meantime, the neighboring vanes 305a, 305b of the plunger strut 38 are aligned with and fit into the recesses 340a, 340b of the first seal 340.

After the first seal 340 is positioned with the vane 305 fully received in the slit
15 345, as shown in Fig. 19B and Fig. 19C, the second seal 70 is rotated towards the strut 38 and with the opposite slit 365 aligned with the corresponding opposite slit 306. Further, as shown in Fig. 19D, the second seal 70 is pushed towards the strut 38 by the hinge pin 328 sliding along the hinge bearing 388, until the vane 306 is fully revised in the slit 365. In the meantime, the other two vanes 305a 305b are clamped between the first and slits 340a,
20 340b and 360a, 360b, respectively. Upon moving the second frame 380 around the hinge pin 328 along the hinge groove 388 such that the first and second frames 320 and 380 are coupled to each other, the area between all four vanes 304, 305a, 305b and 306 of the plunger 30 that form four distinct quadrants become sealed by the slits 345, 355a, 355b and 365 of first and second seals 340, 360. The tolerances of the openings / seams
25 between the slits 345, 355a, 355b and 365 and the struts 38 of the plunger 30 allow the volume space within the inner walls of the barrel 90 and the plunger 30 to be isolated from the outside environment, even when the plunger 30 travels longitudinally along the axis of the barrel 90. The volume space between the back opening 93 of the barrel 90 decreases when the plunger30 is pulled as in drawing fluid contents into the syringe 200, and
30 correspondingly increases when the plunger30 is pushed as in expelling the fluid contents out of the syringe 200. The first seal 340 and second seal 360 are secured to the flange 90 by a lock arm or hook 329 formed on the first frame 320 and a lock catch or pocket 389

formed on the second frame 380, to retain the device in its place at the open end of the barrel 90, for example by clamping the catch members 325, 385 formed on the respective first frame 320 and the second frame 380 onto the flange 98 of the barrel 90 .

CLAIMS

1. A syringe cover device comprising:

a first cap 50 having a first frame 320 and a first seal 340 coupled to the first
5 frame 320;

a second cap 70 having a second frame 380 and a second seal 360 coupled to the
second frame 380;

the first frame 320 and the second frame 380 being couplable to each other to
form an accommodating space 350 therebetween;

10 the first seal 340 and the second seal 360 being couplable to each other to form a
main seal body 352 and disposed in the accommodating space 350, the main
seal body 352 having a first surface 352a abutting against the first frame and
the second frame, a second surface 352b opposite to the first surface and an
aperture 354 formed through the first surface and the second surface.

- 15 2. The syringe cover device of claim 1,

wherein the first frame 320 and the second frame 380 each having a respective
first stopper 320a and a second stopper 380a extending towards the
accommodating space, the first surface of the main seal body abutting against
20 the first stopper and the second stopper, and

wherein upon the first frame 320 and the second frame 380 being secured to a
syringe 200, the first seal 340 and the second seal 360 clamp a plunger strut
38 of the syringe 200 therebetween such that the plunger strut 38 movably
passes through the aperture 354, and the second surface of the main seal body
25 352 is brought into abutment against a flange 98 of the syringe 200 to cover a
back opening 93 of the syringe 200.

3. The syringe cover device of claim 2, wherein the aperture 354 has four slits 345,
355a, 355b, 365 evenly distributed in a polar array about a longitudinal axis 300a,
30 each slit extending in a radial direction 3001/2/3/4r perpendicular to the longitudinal
axis 300a, the first frame 320 having a first retaining arm 324 coupled thereto and
the second frame 380 having a second retaining arm 384 coupled thereto, wherein

the first retaining arm 324 and the second remaining arm 384 are distributed symmetrical about the longitudinal axis 300a and spaced apart from each other with an arm distance therebetween greater than a first width of the flange and .

- 5 4. The syringe cover device of claim 3, wherein the first frame and the second frame are attachable to the flange between a first annular position and a second annular position, upon being at the first annular position, the first retaining arm 324 abuts against a first finger-hold portion 98a of the flange 98 and the second retaining arm abuts against an opposite second finger-hold 98b portion of the flange and upon
10 being at the second annular position, the first retaining arm abuts against the second finger-hold portion of the flange and the second retaining arm abuts against the first finger-hold portion of the flange.
- 15 5. The syringe cover device of claim 2, wherein the main seal body 352 has a first fin 3402, 3602 formed on the first surface 352a and at a periphery of the aperture, and a second fin 3408, 3608 formed on the second surface 352b and at a periphery of the aperture 354, wherein upon the first frame 320 and the second frame 380 being secured to the syringe 200, the first fin and the second fin bias against the plunger strut to form a plunger sealing interface.
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6. The syringe cover device of claim 5, wherein the main seal body having an annular ridge 359 to abut against the flange 98 of the syringe 200 to form a flange sealing interface, wherein the plunger sealing interface and the flange sealing interface seal the back opening of the syringe to prevent liquid communication therethrough.
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7. The syringe cover device of claim 6, wherein the flange sealing interface and the second flange sealing interface are oriented orthogonal to each other.
8. The syringe cover device of claim 2, wherein the first seal 340 and the second seal
30 360 each has a pair of radial recesses 343, 363 and the first frame and the second frame each has a pair of radial projections 323, 383 each of which being received in a respective radial recess.

9. The syringe cover device of claim 2 further comprising an orifice 326 passing through the first frame 320, wherein the orifice establishes air communication between an inner space of the barrel and an outer space of the barrel.

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10. The syringe cover device of claim 9 further comprising an air filter 390 covering the orifice 326.

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11. The syringe cover device of claim 2 further comprising a first support arm extending radially from the first frame 320 and a second support arm extending radially from the second frame 380, a hinge pin 328 projecting axially from the first support arm and a hinge bearing 388 formed on the second support arm, wherein the hinge pin is rotatably received in the hinge bearing to enable relative movement between the first frame 320 and the second frame 380 relative to each other.

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12. The syringe cover device of claim 11, wherein the hinge bearing includes an elongated groove about which the hinge pin is rotatable and along which the hinge pin is slidable to vary a positional relationship between the first frame and the second frame.

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13. The syringe cover device of claim 11, further comprising a lock arm 329 coupled to the first frame 320 and a lock catch 389 coupled to the second frame 380, wherein upon the first frame and the second frame being coupled to each other the lock arm is engaged with the lock catch to secure the first frame and the second frame to each other.

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14. A syringe comprising
a barrel having a front opening, a back opening and a flange formed at the back opening;
a plunger movably disposed in the barrel, the plunger having a plunger strut passing through the back opening and the flange;
a cover device capping the back opening of the barrel;

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wherein the cover device has an aperture through which the plunger strut
movably passes, and an end surface abutting against the flange of the barrel;
wherein the aperture and the plunger strut form a first seal interface to the back
opening, and the end surface of the cap and the flange form a second seal
interface to the back opening.

15. The syringe of claim 14, wherein the cover device comprises:

a first cap 50 having a first frame 320 and a first seal 340 coupled to the first
frame 320;

a second cap 70 having a second frame 380 and a second seal 360 coupled to the
second frame 380;

the first frame 320 and the second frame 380 being coupled to each other to form
an accommodating space 350 therebetween;

the first seal 340 and the second seal 360 being coupled to each other to form a
main seal body 352 and disposed in the accommodating space 350, the main
seal body 352 having a first surface 352a abutting against the first frame and
the second frame, a second surface 352b opposite to the first surface

wherein the aperture 354 is formed through the first surface and the second
surface.

16. The syringe of claim 15,

wherein the first frame 320 and the second frame 380 each having a respective
first stopper 320a and 380a extending towards the accommodating space, the
first surface of the main seal body abutting against the first stopper and the
second stopper, and

wherein upon the first frame 320 and the second frame 380 being secured to a
syringe 200, the first seal 340 and the second seal 360 clamp a plunger strut
30 of the syringe 200 therebetween such that the plunger strut 30 movably
passes through the aperture 354, and the second surface of the main seal body
352 is brought into abutment against a flange 98 of the syringe 200 to cover a
back opening 93 of the syringe 200.

17. The syringe of claim 16, wherein the aperture 354 has four slits 345, 355a, 355b, 365 evenly distributed in a polar array about a longitudinal axis 300a, each slit extending in a radial direction 300r perpendicular to the longitudinal axis 300a, the first frame 320 having a first retaining arm 324 coupled thereto and the second frame 380 having a second retaining arm 384 coupled thereto, wherein the first retaining arm 325 and the second remaining arm 384 are distributed symmetrical about the longitudinal axis 300a and spaced apart from each other with an arm distance therebetween greater than a first width of the flange.
18. The syringe of claim 17, wherein the first frame and the second frame are rotatable relative to the syringe flange about the longitudinal axis between a first position at which the first retaining arm 324 abuts against a first finger-hold portion 98a of the flange 98 and the second retaining arm abuts against a second finger-hold portion 98b of the flange, and a second position at which the first retaining arm abuts against the second finger-hold portion of the flange and the second retaining arm abuts against the first finger-hold portion of the flange.
19. The syringe of claim 15, wherein the main seal body 352 has a first fin 3402, 3602 formed on the first surface 352a and at a periphery of the aperture, and a second fin 3408, 3608 formed on the second surface 352b and at a periphery of the aperture 354, wherein upon the first frame 320 and the second frame 380 being secured to the syringe 200, the first fin and the second fin bias against side surfaces of the plunger strut to form a plunger sealing interface.
20. The syringe of claim 19, wherein the main seal body having an annular ridge 359 to abut against the flange 98 of the syringe 200 to form a flange sealing interface, wherein the plunger sealing interface and the flange sealing interface seal the back opening of the syringe to prevent liquid communication therethrough.
21. The syringe of claim 20, wherein the flange sealing interface and the second flange sealing interface are oriented orthogonal to each other.

22. The syringe of claim 15, wherein the first seal 340 and the second seal 360 each has a pair of radial recesses 343, 363 and the first frame and the second frame each has a pair of radial projections 323, 383 each of which being received in a respective radial recess.
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23. The syringe of claim 22, further comprising an orifice 326 passing through the first frame 320 to establishes air communication between an inner space of the barrel and an outer space of the barrel.
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24. The cover device of claim 23 further comprising an air filter 390 covering the orifice 326.
- 15
25. The syringe of claim 15 further comprising a first support arm extending radially from the first frame 320 and a second support arm extending radially from the second frame 380, a hinge pin 328 projecting axially from the first support arm and a hinge bearing 388 formed on the second support arm, wherein the hinge pin is rotatably received in the hinge bearing to enable relative movement between the first frame 320 and the second frame 380 relative to each other.
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26. The syringe of claim 25, wherein the hinge bearing is an elongated groove about which the hinge pin is rotatable and along which the hinge pin is slidable to vary a positional relationship between the first frame and the second frame.
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27. The syringe of claim 25, further comprising a lock arm 329 formed on the first frame 320 and a lock catch 389 formed on the second frame 380, wherein upon the first frame and the second frame being coupled to each other the lock arm is engaged with the lock catch to secure the first frame and the second frame to each other.