

Certain vial adapters exist that can accommodate multiple sizes of vial closure finishes. Such adapters generally utilize an adapter skirt having a plurality of longitudinal slits. The skirt may have a flare configuration to accept vials of multiple sizes, with the longitudinal slits creating flexible arms. When the cannula is inserted through a cap of a vial, interior aspects of the flexible arms are configured to engage with the vial beneath the cap of the vial. Therefore, the adapter is retained in position on the vial, and because the arms are flexible, the adapter can be retained on vials having different vial closure diameters. However, a practical way to accommodate a range of vial finish sizes, including the large vial finish sizes which are increasingly common in industry, is needed. Hence, those concerned with the development of medical adapters have recognized the need for a single adapter that is usable with vials of different sizes.

United States patent No. US 2010/0179506 discloses a vial adapter element for use in a drug mixing system including a body, a vial connection port extending from the body, a hollow vial puncturing spike that protrudes into the vial connection port and is in fluid communication with a syringe-adapter-element connection port that extends from the body, and a plurality of resilient tongues spaced around an inner wall of the body, the tongues being located in gaps formed in the inner wall of the body.

United States patent No. US 2011/0160701 discloses an apparatus for removal of premixed drugs or reconstitution of lyophilized drugs and for the injection of the reconstituted drug into the patient. The apparatus includes a syringe assembly and an adapter assembly that can be removably connected to a medicament container containing a premixed drug or lyophilized medicament.

United States patent No. US 2011/0022023 discloses a withdrawal spike unit comprising a withdrawal spike component and an integrally formed adapter component that is adapted to couple with a vial in a safe and secure manner. The integral formation of the component parts makes fully automated manufacture and assembly of assemblies comprising such a withdrawal spike unit coupled to a vial possible.

United States patent No. US 2010/0204679 discloses a mixing and injection apparatus including a needle and a needle base, a syringe attachment element and a mixing chamber

engagement assembly including a needle chamber surrounding the needle and a first liquid conduit portion, sealed from the needle chamber and a mixing chamber engagement portion including a
5 second liquid conduit portion communicating with the first liquid conduit portion and configured for communication with a mixing chamber;; the syringe attachment element and the needle base being configured to permit liquid communication between an interior of the syringe and the first liquid conduit portion when the syringe attachment element and the needle base are in the first relative engagement orientation and to permit liquid communication between an interior of the syringe and
10 the needle when the syringe attachment element and the needle base are in the second relative engagement orientation, axially separated from the first relative orientation along the injection axis.

WO 2011/057335 discloses a replaceable needle assembly provided for a retractable, prefilled syringe comprising a barrel having a mounting member and a plunger, whereby the retractable needle can be replaced by a user without affecting the retraction mechanism. The replaceable needle
15 assembly comprises a needle fitted to a retractable needle mount and a needle retainer. The needle mount is removably, screw-threadedly mountable to the mounting member of the barrel. The needle retainer comprises a plurality of fingers that releasably engage the retractable needle to thereby prevent inadvertent retraction of the retractable needle before engagement by the plunger. The plunger comprises a plunger seal comprising an outer member and an inner member that engages the needle
20 for spring-driven retraction. At the end of retraction, a lock is formed between the plunger and barrel to prevent re-use of the syringe.

SUMMARY

In a broad form, the invention is directed to a vial adapter for interconnecting a vial and a fluid delivery device. In one form, the vial adapter is for interconnecting vials having a variety of different
25 closure sizes to said fluid delivery device. In a further or alternative form, the vial adapter is for interconnecting a vial and a fluid delivery device in the form of a safety syringe, wherein the vial adapter minimizes the risk of inadvertently activating a safety mechanism of the safety syringe.

In an aspect, the invention provides a vial adapter as claimed in claim 1.

5 The latitudinal apertures may be slits, windows, slots, cutouts or other apertures that extend laterally within the shroud. Suitably, each flexion arm is a lateral flexion arm. The length and/or number of the latitudinal apertures and/or flexion arms is preferably selected for engaging a vial closure within a broad range of sizes (e.g.diameters). Conveniently, the length of each of the flexion arms is such that when the adapter engages a relatively smaller diameter vial closure, at least one of the flexion

adapter 300 and syringe 400 are disconnected and the replaceable needle assembly is screwed into syringe barrel adapter 420. Additionally or alternatively, fluid 118 can be transferred from syringe 400 to vial 300 or *vice versa* by way of bore 163 of conduit tip 160 and internal aperture or pass-through 151 of cannula 150, to thereby mix with a liquid substance (not shown) in the vial or the syringe. Once mixing has occurred, the mixed fluid is drawn back into the syringe 400. Vial adapter 300 and syringe 400 are disconnected and the replaceable needle assembly is screwed into syringe barrel adapter 420. In the embodiment shown in FIG. 8, cannula 150 and conduit tip 160 are separate components. Alternatively, it is contemplated that cannula 150 and conduit tip 160 could be a single, unitary or integrally-formed structure.

An alternative embodiment of vial adapter 1100 is shown in FIGS 9A and 9B. FIG. 9A is an isometric view of vial adapter 1100 and FIG 9B is a sectional view of adapter 1100. Adapter 1100 comprises housing 1110 having shroud 1130 extending or projecting distally therefrom and conduit tip 1190 projecting from connector 1140 on outer surface 1121 of base 1121, essentially as hereinbefore described. Conduit tip 1160 comprises projection 1162 and internal bore 1163 which permits fluid flow between a fluid delivery device, such as syringe 400 shown in FIG. 8, and a vial closure without risk of premature safety activation, as hereinbefore described. In this embodiment, housing 1120 of vial adapter 1100 comprises shroud 1130 comprising a plurality of longitudinal slits 1131 and longitudinal arms 1132. While longitudinal arms 1132 are capable of elastic deformation to thereby engage or capture a vial closure (or a crimped metal retainer fitted to the vial closure), this embodiment is more suited to vials of a particular size (e.g., diameter) or relatively narrow range of sizes while providing the conduit tip 1160 to prevent or avoid premature activation of syringe safety mechanisms.

It will be appreciated that conduit tip, cannula, base and shroud, connection port, and other components of the vial adapter may be separate or unified components which provide multiple functions. For example and as described previously, the conduit tip and cannula may be separate or a unified, integrally-formed component that functions to prevent retraction activation, the cannula to pierce the sealing membrane of the vial closure and provide a fluid conduit between the fluid container or fluid conduction device and the vial closure. The unified conduit tip and cannula may also be attached to the connector and/or the base and shroud of the vial adapters. In at least

CLAIMS

1. A vial adapter (100, 1100) for interconnecting a fluid delivery device (400) that is a safety syringe (400); and a vial (300) having a closure (320) having a seal (330); said vial adapter comprising an adapter housing (110, 1110). having a base (120), a
5 shroud (130, 1130) extending or projecting from the base and a cannula (150) extending or projecting from the base for penetrating said seal to thereby establish fluid communication between the vial and the vial adapter, wherein the shroud comprises one or a plurality of latitudinal apertures (131, 1131) within at least one of which resides a lateral flexion arm (132) connected at one end to the shroud, each
10 lateral flexion arm capable of engaging and/or retaining the vial closure (320); the vial adapter further comprising a conduit tip (160, 1160) in fluid communication with the cannula (150), the conduit tip further comprising a projection (162, 1162) for preventing or inhibiting inadvertent activation of the safety mechanism of the safety syringe (400).
- 15 2. The vial adapter (100, 1100) of Claim 1, wherein the latitudinal apertures (131, 1131) are, or comprise, slits, windows, slots or cutouts.
3. The vial adapter (100, 1100) of Claim 1 or Claim 2, comprising a plurality of latitudinal apertures (131, 1131) that each comprises a lateral flexion arm (132).
4. The vial adapter (100, 1100) of any preceding claim, wherein each lateral
20 flexion arm (132) is capable of elastic deformation or plastic deformation.
5. The vial adapter (100, 1100) of any preceding claim, wherein each lateral flexion arm (132) further comprises a gripping aspect (134).
6. The vial adapter (100, 1100) of any preceding claim, wherein each lateral
25 flexion arm (132) comprises a snapping aspect to provide audible and/or tactile feedback to the user that the vial adapter is securely attached.
7. The vial adapter (100, 1100) of any preceding claim, wherein the shroud (130, 1130) projects or extends from the base to surround the cannula (150) to protect an operator of the vial adapter from inadvertent puncture by the cannula.
- 30 8. The vial adapter (100, 1100) of any preceding claim which comprises a flare (170) extending or projecting outwardly from a distal end of the shroud (130, 1130).

9. The vial adapter (100, 1100) of any preceding claim, further comprising a connector (140, 1140) which facilitates releasably connecting the vial adapter to said fluid delivery device.

10. The vial adapter (100, 1100) of any preceding claim, which further comprises a
5 gasket (180) internally within the connector (140, 1140) of the vial adapter (100), wherein the gasket minimizes dead space between the vial adapter and the fluid delivery device.

11. The vial adapter (100, 1100) of any preceding claim, which further comprises a collar that at least partly surrounds a connector, wherein the connector facilitates
10 releasably connecting the vial adapter to said fluid delivery device (400).

12.

The vial adapter (100, 1100) of Claim 11, wherein the conduit tip (160) is attachable to the connector (140, 1140).

or is integrally formed with the connector.

13. The vial adapter (100, 1100) of any one of Claims 1-12, wherein the conduit tip
15 is configured to penetrate an aperture in a needle seal of the safety syringe which normally accommodates a retractable needle body and to prevent depression or travel of a plunger of the safety syringe to a point where the safety mechanism is activated.

14. A method of transferring fluid from a vial (300) comprising a closure (320) to a
20 fluid delivery device (400), said method including the step of connecting a vial adapter (100, 1100) according to any one of Claims 1-13 to the closure of the vial and to a safety syringe, and fitting the one or plurality of lateral flexion arms (132) of the vial adapter to the closure so that the vial adapter is in fluid communication with said safety syringe .

15. A kit comprising at least one vial adapter (100, 1100) according to any one of
25 Claims 1-13 and at least one safety syringe, or individual components thereof.