

cannula on the septum upon penetration may superimpose the radial symmetric force, which leads to an unsymmetrical pressure acting on the cannula. Furthermore, after removal of the cannula, optimal sealing of the puncture path can only be achieved if the septum is pierced in a strictly perpendicular manner and along a straight puncturing path.

- 5 In addition, due to design constraints e. g. of a latching arrangement for infusion pump unit and cradle and/or due to the inaccuracy associated with manual, unguided piercing of the septum, the piercing event can be performed as a pivoting movement of the cannula. As a result, certain areas within the septum are stretched, while others are compressed by the pivoting piercing movement of the cannula. These stretching and compressing effects reduce the sealing behaviour of the
10 septum and thus represent an additional source for leakage.

It is therefore an overall objective of the present invention to improve the state of the art regarding the design of cradles for infusion pumps in the context of infusion and/or injection of liquid drugs, thereby preferably avoiding disadvantages of the prior art fully or partly.

- In favorable embodiments, a cradle is provided which guarantees that the septum is pierced
15 perpendicularly to its piercing surface and/or that the septum is pierced along a straight puncturing path.

In further favorable embodiments, a cradle for an infusion pump unit is provided with an increased sealing behavior.

- According to a first aspect of the invention, there is provided a cradle for an infusion pump unit,
20 wherein the cradle has a proximal side and a distal side. The distal side has

an infusion pump unit attachment structure for attaching an initially separate infusion pump unit. The cradle comprises a cradle base, a flow channel for a liquid drug and a pierceable septum. The pierceable septum covers the opening of the flow channel and seals the flow channel. At least an inner piercing core of the pierceable septum is movably mounted with respect to the cradle base.

5 As used herein, the term “septum” is readily understood by those skilled in the art and is typically an engineered element, for example in the form of a membrane or plug, for sealingly separating a first side and second side in a fluid, i.e. gas and/or liquid tight seal, which can be pierced by a cannula. Typically, a septum does not comprise an opening or a puncture, which passes through the septum from the first side to the second side, before a cannula has been pierced through the
10 septum. Consequently, a stump cannula cannot be easily pierced through the septum without exerting high forces. The septum thus seals the flow channel, however allows the penetration of a cannula for establishing a fluid connection.

Typically, the cradle base is rigid or essentially rigid and may be made from a plastic material. The cradle base has usually a flat, disk-like or elongated shape. Furthermore, the cradle base may be
15 defined by a horizontal plane which comprises the disk-like or elongated shaped cradle base and which is in the operative state parallel to the patient’s skin.

In typical embodiments, the flow channel of the cradle may be in fluid connection with a fluid connector, a tubing equipped with an infusion cannula or a tubing with a fluid connector. For example, such a connection may be established by a Luer connector or a suited proprietary fluid
20 connector. In further embodiments, an infusion tubing is directly and permanently connected to the cradle base in fluidic coupling with the flow channel. In such embodiment, the tubing is an integral and inseparable part of the cradle.

The pierceable septum typically comprises an inner piercing core. While in some embodiments, the septum essentially consists of the inner piercing core, in other embodiments, the septum

arm may be pivoted out of the horizontal plane of the cradle base, which may further lead to increased sealing behavior of the septum.

In some embodiments with a pivotable arm, the pivotable arm is pivotable in a lateral direction of the cradle base and/or pivotable out of a horizontal plane of the cradle base.

- 5 According to another aspect of the invention, there is provided a cradle for an infusion pump unit, wherein the cradle has a proximal side and a distal side, the distal side having an infusion pump unit attachment structure for attaching an initially separate infusion pump unit. Furthermore, the cradle comprises a cradle base, a flow channel for a liquid drug and a pierceable septum, which covers an opening of the flow channel and seals the flow channel. The cradle further comprises a guide for
10 providing a linear guiding path. The guide is arranged on the distal side of the cradle and surrounds the flow channel and the pierceable septum. The guide is movable along a piercing axis of the pierceable septum between an initial position and an operating position.

The piercing axis is typically transverse, particularly perpendicular, to a piercing surface of the septum. However, the piercing axis may also have a different angle.

- 15 Typically, the flow channel may be formed by a tubular part of the cradle base. Further, the guide may be at least partially movable along the flow channel. The guide is usually configured to provide a linear guiding path for connecting the cradle with an infusion pump unit via a transfer cannula of the infusion pump unit.

- Thus, the guide may guarantee that the septum is pierced along a linear guiding path, thereby
20 providing a septum with an increased sealing behavior. Additionally, the septum may always accurately be pierced at the same position, as the guide provides a linear guiding path and avoids any deflection from the guiding path, in particular any deflection in a lateral direction of the cradle base. Thus, the septum may always be pierced at the same position and multiple puncturing

According to a further aspect of the invention, there is provided an infusion system comprising a cradle described in any of the embodiments above, and an infusion pump unit with a transfer cannula. The cradle and the infusion pump unit are releasably connectable.

It is understood that in an initial state, the cradle and the infusion pump unit are not yet connected,
5 while in the operating state, the cradle and the infusion pump unit are connected. That is, a fluid connection between the infusion pump unit and the flow channel of the cradle is established.

In some embodiments, the infusion system comprises a cradle with a guide as described in any of the embodiments above, wherein in the initial position, the guide prevents the transfer cannula of the infusion pump unit to pierce the septum before the septum and the transfer cannula are aligned
10 in a predefined state. In the operating position, the transfer cannula can penetrate the septum substantially perpendicular to the piercing surface of the septum.

In some embodiments, the infusion system comprises a cradle with a guide as described in any of the embodiments above, wherein in the initial position, the piercing surface of the septum and the transfer cannula of the infusion pump unit are arranged substantially perpendicular to each other
15 and/or the transfer cannula is arranged above a central area of the piercing surface of the septum. Thus, it is ensured that the septum is always pierced at the same position and consequently the occurrence of multiple puncturing sites is avoided in case of the infusion pump unit and the cradle being coupled and decoupled more than once. Therefore, the amount of coupling and decoupling events may be significantly increased, before leakage occurs or becomes a severe problem.

In preferred embodiments, the infusion system comprises a cradle with a guide as described in any of the embodiments above and the guide is configured such that any lateral relative movement between the cannula and the septum is prevented in the operating position.

In typical embodiments, the transfer cannula of the infusion pump unit is arranged within a recess, which preferably has a shape corresponding to the guide. The shape of the recess may also be tubular in some embodiments. Therefore, the guide may be arranged within the recess in the operating position. Such embodiments are particularly advantageous, as the guiding path provided by the guide is both linear and perpendicular with respect to the piercing surface of the septum.

There is also disclosed pierceable septum comprising a circumferential sealing ring, an inner piercing core and a deformable ribbon. The sealing ring and the inner piercing core are connected by the deformable ribbon. The ribbon is configured such that the inner piercing core of the septum is movable with respect to the sealing ring of the septum. Preferably, the deformable ribbon is configured such that the inner piercing core of the septum may be movable in a lateral direction, i.e. towards a part of the sealing ring of the septum and/or tiltable with respect to a horizontal plane of the septum. It is understood that the horizontal plane of the septum is arranged perpendicular to the outer wall of the sealing ring and perpendicular to a piercing axis of the septum. On the one hand, the ribbon may thus enable movement of the inner piercing core of the pierceable septum and on the other hand enables a gas and/or liquid tight septum sealing the flow channel of the cradle. The septum according to this aspect may in particular be a septum according to an embodiment as discussed above in the context of a cradle and/or further below in the context of exemplary embodiments and the corresponding disclosure is also to be understood as referring to a septum as such.

Claims

1. Cradle for an infusion pump unit, wherein the cradle has a proximal side and a distal side, wherein the distal side has an infusion pump unit attachment structure for attaching an initially separate infusion pump unit; wherein the cradle comprises:
5 a cradle base;
 a flow channel for a liquid drug; and
 a pierceable septum, wherein the pierceable septum covers an opening of the flow channel and seals the flow channel, and wherein at least an inner piercing core of the pierceable septum is movably mounted with respect to the cradle base.
- 10 2. The cradle according to claim 1, wherein the pierceable septum is sealingly connected to the cradle base by clamping or crimping.
3. The cradle according to any of the previous claims, wherein at least the inner piercing core of the pierceable septum is movable in a lateral direction of the cradle base and/or tiltable with respect to a horizontal plane of the cradle base.
- 15 4. The cradle according to any of the previous claims, wherein the pierceable septum comprises a circumferential sealing ring, the inner piercing core and a deformable ribbon, wherein the sealing ring and the inner piercing core are circumferentially connected by the deformable ribbon.
- 20 5. The cradle according to claim 4, wherein the cradle comprises a stopper, wherein the stopper is configured to delimit a movement of the inner piercing core of the septum.
6. The cradle according to any of the previous claims, wherein the cradle comprises a pivotable arm, wherein the pivotable arm at least partially comprises the flow channel, and wherein the septum is arranged on the pivotable arm, and wherein a piercing surface of the septum is essentially parallel to at least a part of the pivotable arm.

7. The cradle according to claim 6, wherein the pivotable arm is pivotable in a lateral direction of the cradle base and/or pivotable out of a horizontal plane of the cradle base.
8. Cradle for an infusion pump unit, wherein the cradle has a proximal side and a distal side, the distal side having an infusion pump unit attachment structure for attaching an initially
5 separate infusion pump unit; wherein the cradle comprises:
 - a cradle base;
 - a flow channel for a liquid drug; and
 - a pierceable septum, wherein the pierceable septum covers an opening of the flow channel and seals the flow channel, the cradle further comprising a guide for providing a
10 linear guiding path, wherein the guide is arranged on the distal side of the cradle, and wherein the guide surrounds the flow channel and the pierceable septum; and wherein the guide is movable along a piercing axis of the pierceable septum between an initial position and an operating position.
9. The cradle according to claim 8, wherein in the initial position the guide protrudes from the
15 flow channel and the pierceable septum.
10. The cradle according to any of claims 8 or 9, wherein the guide is tubular.
11. The cradle according to any of claims 8 to 10, wherein the guide is sliding movable between the initial position and the operating position.
12. Infusion system comprising the cradle according to any of the claims 1 to 11 and an infusion
20 pump unit with a transfer cannula, wherein the cradle and the infusion pump unit are releasably connectable.
13. Infusion system according to claim 12, the infusion system comprising a cradle according to any of claims 8 to 11, wherein in the initial position the guide prevents the transfer cannula of the infusion pump unit to pierce the septum before the septum and the transfer cannula

are aligned in a predefined state, and wherein in the operating position, the transfer cannula can penetrate the septum substantially perpendicular to the piercing surface of the septum.

14. Infusion system according to any of claims 12 or 13, the infusion system comprising a cradle according to any of claims 8 to 11, wherein in the initial position, the piercing surface of the septum and the transfer cannula of the infusion pump unit are arranged substantially perpendicular to each other and/or the transfer cannula is arranged above a central area of the piercing surface of the septum.

15. Infusion system according to any of claims 12 to 14, the infusion system comprising a cradle according to any of claims 8 to 11, wherein the guide is configured such that any lateral relative movement between the transfer cannula and the septum is prevented in the operating position.