A closure for a vial includes a head portion, and a stem portion which projects from a lower surface of the head portion, the stem portion being inserted in an opening of a vial; wherein the stem portion is provided with a small diameter portion and a seal portion, in that order from the lower surface the head portion, the diameter of the small diameter portion being smaller than the diameter of the seal portion. The entirety of the small diameter portion and the seal portion are substantially uniformly fitted in the opening of the vial.
CLOSURE FOR VIAL

BACKGROUND OF THE INVENTION

[0001] Field of the Invention

[0002] The present invention relates to a closure to close an opening of a medical vial (container) which holds therein liquid medicament.

[0003] Description of the Related Art

[0004] In general, a closure (rubber closure) for a vial is made of a rubber material such as butyl rubber and has a cylindrical stem portion which can be inserted in the opening of the vial and a head portion which has a diameter larger than that of the stem portion and which is located on the outside of the opening of the vial. The stem portion of a conventional closure is provided with a close contact portion (barrel portion) having a uniform diameter which is brought into close contact with the opening of the vial and which is located adjacent to the head portion, or is provided on its barrel portion with a sealing annular projection which is in close contact with the opening of the vial. A desired position of such a sealing annular projection is disclosed, for example, in Japanese Unexamined Utility Model No. Sho-61-2233.

[0005] When the stem portion is fitted in the opening of the vial, the sealing annular projection is compressed more than the remaining portion of the barrel portion, and hence, it has been considered that the sealing annular projection contributes to preventing the stem portion from slipping off from the opening of the vial. In particular, for a specific type of vial, called a CS vial (Fuji Glass Co., Ltd.) which is provided, on the end of the opening thereof, with an inner small diameter portion (inner flange), the sealing annular projection engages with the small diameter portion, so that the slip-off prevention effect can be enhanced.

[0006] However, if the closure is used with a vial other than a CS vial, the sealing annular projection which is compressed more than the remaining portion sometimes produces a force in a direction opposite to the direction of insertion to thereby disengage the closure from the vial. Because of this phenomenon, the sealing annular projection has also been regarded as having an opposite effect to that of slip-off prevention.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to eliminate the drawbacks and resolve the problems mentioned above, by providing a closure for a vial in which the slip-off prevention effect of the closure from the vial can be enhanced.

[0008] It has been conceived by the inventors that by providing a small diameter portion on the end of the stem portion adjacent to the head portion, instead of a sealing annular projection, the material of the portion of the stem portion of the closure that is compressed when the stem portion is inserted in the opening of the vial is moved into the small diameter portion. Consequently, no force to disengage the closure from the vial opening occurs, unlike the conventional closure having the sealing annular projection.

[0009] To achieve the object mentioned above, according to the present invention, a closure for a vial is provided, including a head portion, and a stem portion which projects from a lower surface of the head portion, the stem portion being inserted in an opening of a vial; wherein the stem portion is provided with a small diameter portion and a seal portion, in that order from the lower surface the head portion, the diameter of the small diameter portion being smaller than the diameter of the seal portion. The entirety of the small diameter portion and the seal portion are substantially uniformly fitted in the opening of the vial.

[0010] Preferably, the following condition is satisfied:

[0011] \( 0.80 \leq d \leq 0.98 \)D; wherein \( d \) designates the diameter of the small diameter portion, and \( D \) designates the diameter of the seal portion.

[0012] Preferably, the stem portion is further provided with a leg portion connected to the seal portion, the leg portion being provided with at least one radial opening and a plurality of half-insertion projections formed on the outer peripheral surface of the seal portion, the diameter of the seal portion being smaller than the diameter of a circumcribed circle of the half-insertion projections.

[0013] Preferably, the following condition is satisfied:

[0014] \( S/\text{j}\leq S/20 \); wherein \( j \) designates the axial length of the small diameter portion, and \( S \) designates the axial length of the seal portion.


BRIEF DESCRIPTION OF THE INVENTION

[0016] FIG. 1 is a partially sectional perspective view of a closure for a vial, according to an embodiment of the present invention;

[0017] FIG. 2 is a front elevation view of a closure for a vial shown in FIG. 1; and

[0018] FIG. 3 is a back view of a closure for a vial shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] A closure 10 for a vial 20 according to the present invention is composed of a head portion (top plate) 11 in the form of a circular disc, and a cylindrical stem portion 12, which has a diameter smaller than that of the head portion 11 and which projects from the lower surface of the head portion 11. The stem portion 12 is fitted in an opening (bottle neck) 21 of the vial (container for holding liquid medicament) 20. The head portion 11 is in contact with an end face 22 of the opening 21.

[0020] The stem portion 12 is provided with a seal portion 13 adjacent to the head portion 11 and a leg portion 14 connected to the seal portion 13. The seal portion 13 is provided on its end adjacent to the head portion 11, with a small diameter portion 15 having a smaller diameter. The seal portion 13 has a uniform diameter D which is slightly greater than the uniform inner diameter x of the opening 21 of the vial 20, so that when the stem portion is inserted in the opening 21, the seal portion 13 is uniformly compressed to establish a press fit therebetween. There is no scaling
annular projection or other projection provided on the closure 10, unlike a conventional closure for a vial. In an alternative embodiment, the seal portion 13 can be provided with a slightly tapered peripheral surface.

[0021] The diameter \( d \) and axial length (width) \( j \) of the small diameter portion 15 are determined, taking into account a difference in the diameter between the seal portion 13 and the opening 21, so that when the seal portion 13 is fitted in the opening 21 of the vial 20, the material of the portion of the seal portion 13 that is compressed and deformed is moved into the small diameter portion 15 so that no force is produced which would cause the closure 10 to disengage from the vial 20. More specifically, the diameter \( d \) of the small diameter portion 15 is preferably in the range of \( d = 0.80D \) to \( 0.98D \) (0.80D ≤ \( d \) ≤ 0.98D), wherein \( D \) is the diameter of the seal portion 13. The axial length \( j \) of the seal portion 15 is preferably in the range of \( j = \frac{1}{2} \text{ through } \frac{3}{2} \text{ } S \) (i.e., \( S/5 \leq j \leq S/20 \)), wherein \( S \) is the axial length of the seal portion 13. By way of example, in the closure 10 constructed as above, the diameter of the head portion 11 is in the range of 10 mm through 30 mm and the overall length of the stem portion 12 is in the range of 5 mm through 30 mm.

[0022] The leg portion 14 of the stem portion 12 is provided with a radial opening 16 through which cleaning liquid can easily enter the stem portion 12. The leg portion 14 is provided on its outer peripheral surface with a plurality of half-insertion projections 17 (three projections in the illustrated in FIG. 2) at an equal angular distance. When the stem portion 12 of the closure 10 is inserted in the opening 21 of the vial 20, the projections 17 first engage with the inner peripheral surface of the opening 21 to provisionally hold the closure 10 while keeping the posture thereof before the closure 10 is completely inserted in the vial 20. The outer diameter \( D \) of the seal portion 13 is smaller than a diameter \( T \) of a circumscribed circle to the projections 17. If the diameter \( D \) were substantially identical to the diameter \( T \), it would be impossible to completely insert the closure 10 in the vial 20. If the diameter of the circumscribed circle is larger than the outer diameter \( D \), the stem portion can be easily deformed due to the presence of the opening 16, so that the closure 10 can be half-inserted easily. The opening 16 and the projections 17 can be appropriately increased in number.

[0023] The closure 10 is forced (press-fitted) into the opening 21 of the vial 20, after the vial 20 is filled with liquid medication. Upon the closure 10 being press-fitted into the vial 20, the leg portion 14 of the stem portion 12 is elastically deformed and is inserted in the opening 21. Consequently, the projections 17, provided on the outer peripheral surface of the stem portion 14, are frictionally engaged with the inner surface of the opening 21 of the vial 20 to establish a provisional holding (half-insertion state). Thereafter, when the closure 10 is further inserted into the opening 21, the seal portion 13 is pressed onto and brought into uniform surface contact with the inner peripheral surface of the opening 21 of the vial 20, so that the lower surface (under surface) of the head portion 11 comes into contact with the end face 22 of the opening 21. Thus, the complete insertion of the closure 10 into the vial 20 is obtained. In this state, the material of the portion of the seal portion 13 is partly moved into and received in the small diameter portion 15. Hence, there is no or little possibility that the elastic deformation of the seal portion 13 causes the closure 10 to slip off from the vial 20.

[0024] As can be understood from the above discussion, according to the present invention, the stem portion of the closure for a vial is provided, on the portion thereof adjacent to the head portion, with a seal portion that is entirely fitted in and brought into close surface-contact with the inner surface of the opening of the vial, and the seal portion is provided on an end thereof adjacent to the head portion with a small diameter portion whose diameter is smaller than the diameter of the main body of the seal portion. According to this construction, no slipping force is applied to the closure when the closure is fitted in the vial.

[0025] Obvious changes may be made in the specific embodiments of the present invention described herein, such modifications being within the spirit and scope of the invention claimed. It is indicated that all matter contained herein is illustrative and does not limit the scope of the present invention.

What is claimed is:
1. A closure for a vial comprising:
   a head portion; and
   a stem portion which projects from a lower surface of the head portion, said stem portion being inserted in an opening of a vial;
   wherein said stem portion is provided with a small diameter portion and a seal portion, in that order from said lower surface the head portion, the diameter of said small diameter portion being smaller than the diameter of the seal portion;
   and wherein the entirety of said small diameter portion and said seal portion are substantially uniformly fitted in the opening of the vial.
2. The closure for a vial according to claim 1, wherein the following condition is satisfied:
   \( 0.80D \leq d \leq 0.98D \);
   wherein
   \( d \) designates the diameter of the small diameter portion;
   and
   \( D \) designates the diameter of the seal portion.
3. The closure for a vial according to claim 1, wherein the stem portion is further provided with a leg portion connected to the seal portion, said leg portion being provided with at least one radial opening and a plurality of half-insertion projections formed on the outer peripheral surface of the seal portion, the diameter of the seal portion being smaller than the diameter of a circumscribed circle of the half-insertion projections.
4. The closure for a vial according to claim 1, wherein the following condition is satisfied:
   \( S/5 \leq j \leq S/20 \);
   wherein
   \( j \) designates the axial length of the small diameter portion;
   and
   \( S \) designates the axial length of the seal portion.