more of the following advantages compared to conventional slit-type silicone valves (1) ease of manufacture and/or assembly, (2) relatively low cost of manufacture and/or assembly, and (3) accommodation of the manufacture of the valve by means of efficient, high-quality, large-volume techniques with a reduced product reject rate to produce valves with consistent operating characteristics.

[0011] The inventors of the present invention have discovered how to provide such a valve that includes novel, advantageous features not heretofore taught or contemplated by the prior art, and which can accommodate designs having one or more of the above-discussed benefits or features.

BRIEF SUMMARY OF THE INVENTION

[0012] The inventors of the present invention have discovered how to provide an improved lower cost valve system for permitting selective communication through the valve (from one side to the other) to accommodate flow of a fluent substance therethrough. The valve may be assembled with, or provided within, a package or container of a fluent substance, or a fluid handling system (such as a fluent substance dispensing system), that has an opening between the exterior and interior of the container or system at which the valve can be installed.

[0012A] According to a first aspect of the present invention, there is provided a valve to permit selective communication therethrough, said valve comprising:

a base defining a central axis;

a post connected to said base;

at least one flow aperture in said base and/or said post; and

a flexible membrane having an orifice and having a non-dispensing configuration wherein said orifice is located proximate to said post to minimize communication through said valve, and said flexible membrane having a dispensing configuration wherein said orifice is moved away from said post for establishing communication through said valve,

wherein said flexible membrane includes a peripheral wall for sealing against a portion of said base and a transverse wall extending inwardly of said peripheral wall and defining said orifice, and said peripheral wall defines a top end and a bottom end, wherein said transverse wall extends from said bottom end and is located axially inwardly of said top end with said flexible membrane in said non-dispensing configuration, relative to said central axis.

[0012B] According to a second aspect of the present invention, there is provided a valve to permit selective communication therethrough, said valve comprising:

a base defining a central axis;

a post connected to said base;

at least one flow aperture in said base and/or said post; and

a flexible membrane having an orifice and having a non-dispensing configuration wherein said orifice is located proximate to said post to minimize communication through said valve, and said flexible membrane having a dispensing configuration wherein said orifice is moved away from said post for establishing communication through said valve,

wherein said flexible membrane does not contact, and is spaced axially outwardly from, a distal end of said post with said flexible membrane in said non-dispensing configuration.

[0012C] According to a third aspect of the present invention, there is provided a valve to permit selective communication therethrough, said valve comprising:

a base defining a central axis;

a post connected to said base;

at least one flow aperture in said base and/or said post; and

a flexible membrane having an orifice and having a non-dispensing configuration wherein said orifice is located proximate to said post to minimize communication through said valve, and said flexible membrane having a dispensing configuration wherein said orifice is moved away from said post for establishing communication through said valve,

wherein said base includes an outer wall surrounding said post, said outer wall includes a flange extending laterally outwardly therefrom, said flange includes a channel to accommodate movement of said flexible membrane relative to said base.

[0013] According to one broad embodiment~~aspect~~ of the invention, the valve includes a base defining a central axis, and a post connected to the base and extending axially outwardly from the base, in the direction along the central axis. The valve includes at least one flow aperture that may be formed in one or both of the base and/or the post. The valve further includes a flexible membrane defining an orifice and a non-dispensing configuration wherein the orifice is located proximate to the post to minimize, or at least restrict, communication of a fluent substance through the valve. The flexible membrane has a dispensing configuration wherein the orifice is moved away from the non-dispensing configuration proximate to the post for establishing or permitting a substantial communication of a fluent substance through the valve.

[0014] According to one ~~aspect~~embodiment of the invention, the valve is formed as a unitary construction, preferably from a single thermoplastic elastomer for being installed in either a closure for a container or directly in the container without the need for any retaining ring or adhesive.

[0015] According to another~~ne aspect~~embodiment of the invention, the base and the flexible membrane are connected by a hinge. Preferably, the base and the flexible membrane have a generally planar, as-molded configuration, wherein the flexible membrane is configured to be rotated about the hinge away from the generally planar, as-molded configuration into the non-dispensing configuration such that the orifice is located around the post. Preferably, the orifice of the flexible membrane is circular.

[0016] In another embodiment~~aspect~~ of the invention, the least one flow aperture has the form of a pair of diametrically opposing flow apertures extending through each of the base and the post.

[0017] In yet another embodiment~~aspect~~ of the invention, the post is generally cylindrical and terminates in a distal end. Preferably, the distal end extends axially outwardly of the flexible membrane in the non-dispensing configuration, relative to the central axis. According to one preferred embodiment, the post terminates in a distal end having a frustoconical cross-sectional shape, when viewed in a vertical plane containing the central axis. In another embodiment, the post terminates in a substantially flat distal end.

[0018] According to one embodiment~~aspect~~ of the invention, the flexible membrane includes a peripheral wall for sealing against a portion of the base and a transverse wall extending laterally inwardly of the peripheral wall and defining the orifice. Preferably, the peripheral wall defines a top end and a bottom end, wherein the transverse wall extends from the bottom end and is located axially inwardly (toward the container interior along the central axis) of the top end with the flexible membrane in the non-dispensing (i.e., ready to dispense) configuration. Still more preferably, the transverse wall is substantially flat with the flexible membrane in the non-dispensing configuration.

[0019] In another form of the present invention, the base includes an outer wall surrounding the post and an inner wall extending laterally inwardly from the outer wall.

WHAT IS CLAIMED IS:

~~1. A valve (100) to permit selective communication therethrough, said valve (100) comprising:~~

~~a base (110) defining a central axis (114);~~

~~a post (118) connected to said base (110);~~

~~at least one flow aperture (122) in said base (110) and/or said post (118); and~~

~~a flexible membrane (126) having an orifice (130) and having a non-dispensing configuration wherein said orifice (130) is located proximate to said post (118) to minimize communication through said valve (100), and said flexible membrane (126) having a dispensing configuration wherein said orifice (130) is moved away from said post (118) for establishing communication through said valve (100).~~

~~2. The valve (100) according to claim 1 wherein said base (110) and said flexible membrane (126) are a unitary structure.~~

~~3. The valve (100) according to claim 1 wherein said base (110) and said post (118) are a unitary structure.~~

~~4. The valve (100) according to claim 1 wherein said base (110), said post (118), and said flexible membrane (126) are a unitary structure.~~

~~5. The valve (100) according to claim 1 wherein said base (110), said post (118), and said flexible membrane (126) are an injection molded unitary structure formed from a thermoplastic elastomer.~~

~~6. The valve (100) according to claim 1 wherein said base (110) and said flexible membrane (126) are connected by a hinge (134).~~

~~7. The valve (100) according to claim 1 wherein said base (110) and said flexible membrane (126) are connected by a hinge (134) and have a generally planar, as-molded configuration, and wherein said flexible membrane (126) is configured to be~~

~~rotated about said hinge (134) away from said generally planar, as-molded configuration into said non-dispensing configuration such that said orifice (130) is located around said post (118).~~

~~8. The valve (100) according to claim 1 wherein said at least one flow aperture (122) has the form of a pair of diametrically opposing flow apertures (122) extending through each of said base (110) and said post (118).~~

~~9. The valve (100) according to claim 1 wherein said post (118) is generally cylindrical and terminates in a distal end (138).~~

~~10.The valve (100) according to claim 1 wherein said post (118) includes a distal end (138) that extends axially outwardly of said flexible membrane (126) in said non-dispensing configuration, relative to said central axis (114).~~

~~11.The valve (100) according to claim 1 wherein said post (118) terminates in a distal end (138) having a frustoconical cross-sectional shape, when viewed in a vertical plane containing said central axis (114).~~

~~12.The valve (100) according to any preceding claims wherein said post (118) terminates in a substantially flat distal end (138).~~

~~13.The valve (100) according to claim 1 wherein said flexible membrane (126) includes a peripheral wall (142) for sealing against a portion of said base (110) and a transverse wall (146) extending laterally inwardly of said peripheral wall (142) and defining said orifice (130).~~

~~14.~~1. ~~The~~A valve ~~(100)~~ to permit selective communication therethrough, said valve comprising: ~~according to claim 1~~

a base defining a central axis;

a post connected to said base;

at least one flow aperture in said base and/or said post; and

a flexible membrane having an orifice and having a non-dispensing configuration wherein said orifice is located proximate to said post to minimize communication through said valve, and said flexible membrane having a dispensing configuration wherein said orifice is moved away from said post for establishing communication through said valve,

wherein said flexible membrane ~~(126)~~ includes a peripheral wall ~~(142)~~ for sealing against a portion of said base ~~(110)~~ and a transverse wall ~~(146)~~ extending inwardly of said peripheral wall ~~(142)~~ and defining said orifice ~~(130)~~, and said peripheral wall ~~(142)~~ defines a top end and a bottom end, wherein said transverse wall ~~(146)~~ extends from said bottom end and is located axially inwardly of said top end with said flexible membrane ~~(126)~~ in said non-dispensing configuration, relative to said central axis ~~(114)~~.

~~15. The valve (100) according to claim 1 wherein said flexible membrane (126) includes a peripheral wall (142) for sealing against a portion of said base (110) and a transverse wall (146) extending laterally inwardly of said peripheral wall (142), said transverse wall (146) being substantially flat with said flexible membrane (126) in said non-dispensing configuration.~~

~~16. The valve (100) according to claim 1 wherein said base (110) includes an outer wall (162) surrounding said post (118) and an inner wall (166) extending laterally inwardly from said outer wall (162).~~

~~17. The valve (100) according to claim 1 wherein said base (110) includes an outer wall (162) surrounding said post (118) and an inner wall (166) extending laterally inwardly from said outer wall (162), said flexible membrane (126) includes a peripheral wall (142) for sealing against said outer wall (162) of said base (110) and a transverse wall (146) extending laterally inwardly of said peripheral wall (142) and defining said orifice (130).~~

~~18. The valve (100) according to claim 1 wherein said base (110) includes an outer wall (162) surrounding said post (118) and said flexible membrane (126) includes a peripheral wall (142) for sealing against said outer wall (162) of said base (110), said outer wall (162) and/or said peripheral wall (142) including at least one annular projection for maintaining said flexible membrane (126) in said non-dispensing configuration.~~

~~19. The valve (100) according to claim 1 wherein said flexible membrane (126) does not contact, and is spaced laterally from, a lateral surface (119) of said post (118) with said flexible membrane (126) in said non-dispensing configuration.~~

~~20. The valve (100) according to claim 1 wherein said flexible membrane (126) seals against a lateral surface (119) of said post (118) with said flexible membrane (126) in said non-dispensing configuration.~~

~~21.~~2. ~~The~~A valve ~~(100)~~ to permit selective communication therethrough, said valve comprising: ~~according to claim 1~~

a base defining a central axis;

a post connected to said base;

at least one flow aperture in said base and/or said post; and

a flexible membrane having an orifice and having a non-dispensing configuration wherein said orifice is located proximate to said post to minimize communication through said valve, and said flexible membrane having a dispensing configuration wherein said orifice is moved away from said post for establishing communication through said valve,

wherein said flexible membrane ~~(126)~~ does not contact, and is spaced axially outwardly from, a distal end ~~(138)~~ of said post ~~(118)~~ with said flexible membrane ~~(126)~~ in said non-dispensing configuration.

~~22.The valve (100,) according to claim 1 wherein said flexible membrane (126) seals axially against a distal end (138) of said post (118) with said flexible membrane (126) in said non-dispensing configuration.~~

~~23.The valve (100) according to claim 1 wherein said orifice (130) of said flexible membrane (126) is circular.~~

~~24.The valve (100) according to claim 1 wherein said flexible membrane (126) is resilient and configured to move from said dispensing configuration to said non-dispensing configuration when said flexible membrane (126) is subjected to a pressure differential below a predetermined threshold.~~

~~25.The valve (100) according to claim 1 wherein said base (110) includes an outer wall (162) surrounding said post (118), said outer wall (162) includes a flange (163) extending laterally outwardly therefrom.~~

~~26.~~3. ~~The~~A valve ~~(100)~~ to permit selective communication therethrough, said valve comprising:~~according to claim 1~~

a base defining a central axis;

a post connected to said base;

at least one flow aperture in said base and/or said post; and

a flexible membrane having an orifice and having a non-dispensing configuration wherein said orifice is located proximate to said post to minimize communication through said valve, and said flexible membrane having a dispensing configuration wherein said orifice is moved away from said post for establishing communication through said valve,

wherein said base ~~(110)~~ includes an outer wall ~~(162)~~ surrounding said post ~~(118)~~, said outer wall ~~(162)~~ includes a flange ~~(163)~~ extending laterally outwardly therefrom, said flange ~~(163)~~ includes a channel ~~(164)~~ to accommodate movement of said flexible membrane ~~(126)~~ relative to said base ~~(110)~~.

~~27. The valve (100) according to claim 1 in combination with a closure (200) for a container, the container having an opening between an exterior of the container and an interior of the container where a fluent substance may be stored.~~

~~28. The valve (100) according to claim 1 in combination with a closure (200) for a container, said valve (100) arranged in said closure (200) at a location that is axially inward of an opening (210) of said closure (200).~~

~~29. The valve (100) according to claim 1 in combination with a closure (200) for a container, said valve (100) including a flange (163) extending laterally outwardly therefrom and said closure (200) including at least one projection (220) for engaging said flange (163) to retain said valve (100).~~

~~30. The valve (100) according to claim 1 in combination with a closure (200) and a container of a fluent substance.~~

~~31. The valve (100) according to claim 1 wherein said flexible membrane (126) further has an in-venting configuration wherein said flexible membrane (126) is moved inwardly from said non-dispensing configuration to permit an inflow of air through said valve (100).~~

~~32. A valve (100) to permit selective communication therethrough, said valve (100) comprising:~~

~~a base (110) defining a central axis (114);~~

~~a post (118) connected to said base (110);~~

~~at least one flow aperture (122) in said base (110) and/or said post (118); and~~

~~a flexible membrane (126) having an orifice (130) and having a non-dispensing configuration wherein said orifice (130) is located proximate to said post (118) to minimize communication of a fluent substance through said valve (100), and said flexible membrane (126) having a dispensing configuration wherein said orifice (130) is~~

moved away from said post (118) for establishing communication of a fluent substance through said valve (100), wherein said base (110), said post (118), and said flexible membrane (126) are a unitary structure.

33.A valve (100) to permit selective communication therethrough, said valve (100) comprising:

a base (110) defining a central axis (114);

a post (118) connected to said base (110);

at least one flow aperture (122) in said base (110) and/or said post (118); and

a flexible membrane (126) having an orifice (130) and having a non-dispensing configuration wherein said orifice (130) is located proximate to said post (118) to minimize communication of a fluent substance through said valve (100), and said flexible membrane (126) having a dispensing configuration wherein said orifice (130) is moved away from said post (118) for establishing communication of a fluent substance through said valve (100), wherein said base (110) and said flexible membrane (126) are each separately formed structures.

34.A valve (100) to permit selective communication therethrough, said valve (100) comprising:

a base (110) defining a central axis (114);

a post (118) connected to said base (110);

at least one flow aperture (122) in said base (110) and/or said post (118); and

a flexible membrane (126) having an orifice (130) and having a non-dispensing configuration wherein said orifice (130) is located proximate to said post (118) to minimize communication of a fluent substance through said valve (100), and said flexible membrane (126) having a dispensing configuration wherein said orifice (130) is moved away from said post (118) for establishing communication of a fluent substance through said valve (100), and wherein said flexible membrane (126) further has an inventing configuration wherein said flexible membrane (126) is moved inwardly from said non-dispensing configuration to permit an inflow of air through said valve (100).

35. A valve (100) to permit selective communication therethrough, said valve (100) comprising:

a base (110) defining a central axis (114);

a post (118) connected to said base (110);

at least one flow aperture (122) in said base (110) and/or said post (118); and

a flexible membrane (126) having an orifice (130) and having a non-dispensing configuration wherein said orifice (130) is located proximate to said post (118) to minimize communication through said valve (100), and said flexible membrane (126) having a dispensing configuration wherein said orifice (130) is moved away from said post (118) for establishing communication through said valve (100).

36. The valve (100) according to claim 35 wherein said base (110) and said flexible membrane (126) are a unitary structure.

37. The valve (100) according to any of claims 35-36 wherein said base (110) and said post (118) are a unitary structure.

38. The valve (100) according to any of claims 35-37 wherein said base (110), said post (118), and said flexible membrane (126) are a unitary structure.

39. The valve (100) according to any of claims 35-38 wherein said base (110), said post (118), and said flexible membrane (126) are an injection molded unitary structure formed from a thermoplastic elastomer.

40. The valve (100) according to any of claims 35-39 wherein said base (110) and said flexible membrane (126) are connected by a hinge (134).

41. The valve (100) according to any of claims 35-40 wherein said base (110) and said flexible membrane (126) are connected by a hinge (134) and have a generally planar, as-molded configuration, and wherein said flexible membrane (126) is configured to be rotated about said hinge (134) away from said generally planar, as-

~~molded configuration into said non-dispensing configuration such that said orifice (130) is located around said post (118).~~

~~42.The valve (100) according to any of claims 35-41 wherein said at least one flow aperture (122) has the form of a pair of diametrically opposing flow apertures (122) extending through each of said base (110) and said post (118).~~

~~43.The valve (100) according to any of claims 35-42 wherein said post (118) is generally cylindrical and terminates in a distal end (138).~~

~~44.The valve (100) according to any of claims 35-43 wherein said post (118) includes a distal end (138) that extends axially outwardly of said flexible membrane (126) in said non-dispensing configuration, relative to said central axis (114).~~

~~45.The valve (100) according to any of claims 35-44 wherein said post (118) terminates in a distal end (138) having a frustoconical cross-sectional shape, when viewed in a vertical plane containing said central axis (114).~~

~~46.The valve (100) according to any of claims 35-44 wherein said post (118) terminates in a substantially flat distal end (138).~~

~~47.The valve (100) according to any of claims 35-46 wherein said flexible membrane (126) includes a peripheral wall (142) for sealing against a portion of said base (110) and a transverse wall (146) extending laterally inwardly of said peripheral wall (142) and defining said orifice (130).~~

~~48.The valve (100) according to any of claims 35-47 wherein said flexible membrane (126) includes a peripheral wall (142) for sealing against a portion of said base (110) and a transverse wall (146) extending inwardly of said peripheral wall (142) and defining said orifice (130), and said peripheral wall (142) defines a top end and a bottom end,~~

~~wherein said transverse wall (146) extends from said bottom end and is located axially inwardly of said top end with said flexible membrane (126) in said non-dispensing configuration, relative to said central axis (114).~~

~~49. The valve (100) according to any of claims 35-48 wherein said flexible membrane (126) includes a peripheral wall (142) for sealing against a portion of said base (110) and a transverse wall (146) extending laterally inwardly of said peripheral wall (142), said transverse wall (146) being substantially flat with said flexible membrane (126) in said non-dispensing configuration.~~

~~50. The valve (100) according to any of claims 35-49 wherein said base (110) includes an outer wall (162) surrounding said post (118) and an inner wall (166) extending laterally inwardly from said outer wall (162).~~

~~51. The valve (100) according to any of claims 35-50 wherein said base (110) includes an outer wall (162) surrounding said post (118) and an inner wall (166) extending laterally inwardly from said outer wall (162), said flexible membrane (126) includes a peripheral wall (142) for sealing against said outer wall (162) of said base (110) and a transverse wall (146) extending laterally inwardly of said peripheral wall (142) and defining said orifice (130).~~

~~52. The valve (100) according to any of claims 35-51 wherein said base (110) includes an outer wall (162) surrounding said post (118) and said flexible membrane (126) includes a peripheral wall (142) for sealing against said outer wall (162) of said base (110), said outer wall (162) and/or said peripheral wall (142) including at least one annular projection for maintaining said flexible membrane (126) in said non-dispensing configuration.~~

~~53. The valve (100) according to any of claims 35-52 wherein said flexible membrane (126) does not contact, and is spaced laterally from, a lateral surface (119) of said post (118) with said flexible membrane (126) in said non-dispensing configuration.~~

~~54.The valve (100) according to any of claims 35-52 wherein said flexible membrane (126) seals against a lateral surface (119) of said post (118) with said flexible membrane (126) in said non-dispensing configuration.~~

~~55.The valve (100) according to any of claims 35-52 wherein said flexible membrane (126) does not contact, and is spaced axially outwardly from, a distal end (138) of said post (118) with said flexible membrane (126) in said non-dispensing configuration.~~

~~56.The valve (100,) according to any of claims 35-52 wherein said flexible membrane (126) seals axially against a distal end (138) of said post (118) with said flexible membrane (126) in said non-dispensing configuration.~~

~~57.The valve (100) according to any of claims 35-56 wherein said orifice (130) of said flexible membrane (126) is circular.~~

~~58.The valve (100) according to any of claims 35-57 wherein said flexible membrane (126) is resilient and configured to move from said dispensing configuration to said non-dispensing configuration when said flexible membrane (126) is subjected to a pressure differential below a predetermined threshold.~~

~~59.The valve (100) according to any of claims 35-58 wherein said base (110) includes an outer wall (162) surrounding said post (118), said outer wall (162) includes a flange (163) extending laterally outwardly therefrom.~~

~~60.The valve (100) according to any of claims 35-59 wherein said base (110) includes an outer wall (162) surrounding said post (118), said outer wall (162) includes a flange (163) extending laterally outwardly therefrom, said flange (163) includes a channel (164) to accommodate movement of said flexible membrane (126) relative to said base (110).~~

~~61. The valve (100) according to any of claims 35-60 in combination with a closure (200) for a container, the container having an opening between an exterior of the container and an interior of the container where a fluent substance may be stored.~~

~~62. The valve (100) according to any of claims 35-61 in combination with a closure (200) for a container, said valve (100) arranged in said closure (200) at a location that is axially inward of an opening (210) of said closure (200).~~

~~63. The valve (100) according to any of claims 35-62 in combination with a closure (200) for a container, said valve (100) including a flange (163) extending laterally outwardly therefrom and said closure (200) including at least one projection (220) for engaging said flange (163) to retain said valve (100).~~

~~64. The valve (100) according to any of claims 35-63 in combination with a closure (200) and a container of a fluent substance.~~

~~65. The valve (100) according to any of claims 35-64 wherein said flexible membrane (126) further has an in-venting configuration wherein said flexible membrane (126) is moved inwardly from said non-dispensing configuration to permit an inflow of air through said valve (100).~~