Claims

1. A vacuum-actuated valve assembly (10), comprising:

a modified bellows (13) defined at least in part by an enclosed chamber (18) sealed to isolate said chamber (18) from an outside region (14) surrounding the bellows (13), said bellows (13) comprising side regions (31) configured to longitudinally expand in response to a predetermined vacuum condition surrounding the outside region (14) of the bellows (13), said bellows (13) having a top portion threadably engaged to a port body (21) along an outer diameter of the bellows (13), and said bottom portion of the bellows (13) substantially defined by a contact plate (19);

a pin (17) having a top end extending towards the bottom portion of the bellows (13) and a bottom end extending through an opening (28) of a stationary thermoplastic seat (11) and an opening (29) in a top portion (16) of a stabber (12) to contact a surface of the stabber (12);

the stationary seat (11) consisting essentially of a thermoplastic material and further wherein said thermoplastic seat (11) is characterized by the absence of elastomeric material, said stationary seat (11) comprising the opening (28) extending from an outer surface (27) of the seat (11) to an inner sealing surface (26) of the seat (11), said seat (11) further comprising a grooved region (15) extending along said inner sealing surface (26) of said stationary seat (11);

the stabber (12) comprising a body portion (30) and the top portion (16) each of which is situated within the interior of the stationary seat (11), said interior of the stationary seat (11) defined, at least in part, by an inner diameter greater than an outer diameter of the top portion (16) and an outer diameter of the body portion (30) thereby creating a passageway (20) between the stabber (12) and the seat (11);

wherein said top portion (16) of the stabber (12) is engaged within said grooved region (15) of the stationary seat (11) so as to be maintained in mechanical engagement therealong

when the bellows (13) is in a non-expanded state, said engagement creating a seal that blocks the passageway (20) and prevents the flow of fluid therethrough, thereby creating a closed configuration of the valve assembly (10);

wherein expansion of the bellows (13) along the side regions (31) in a longitudinal direction in response to the predetermined vacuum condition surrounding the outside region (14) of the bellows (13) increases the length of the side regions (31) of the bellows (13) by an incremental amount sufficient to urge the contact plate (19) downward against the top end of the pin (17), thereby causing said bottom end of the pin (17) to push down against the surface of the stabber (12) and disengage the top portion (16) of the stabber (12) from within the grooved region (15) along the inner sealing surface (26) of the stationary seat (11), thereby mechanically disengaging the seal to unblock the passageway (20) and create a gap between the top portion (16) of the stabber (12) and the inner sealing surface (26) of the stationary seat (11) to create an open configuration of the valve assembly (10) for the fluid to pass therethrough.

2. The vacuum-actuated valve assembly (10) of claim 1, wherein said grooved region (15) of the seat (11) comprises a coined surface configured to elastically compress within a predetermined elastic-like zone upon engagement with the top portion of the stabber.

3. The vacuum-actuated valve assembly (10) of claim 1, wherein said top portion is a frusto-conical shape.

4. The vacuum-actuated valve assembly (10) of claim 1 disposed within an interior of a storage and delivery device (2).

5. The vacuum-actuated valve assembly (10) of claim 1, wherein said stationary seat (11) remains substantially unaltered in shape during one or more cycles of transitioning between the open configuration and the closed configuration.

6. The vacuum-actuated valve assembly (10) of claim 1, wherein a single revolution of the threaded bellows (13) translates into a delivery pressure change of about 10 torr.

7. The vacuum-actuated valve assembly (10) of claim 1, wherein said top portion (16) of said stabber (12) circumferentially extends along said inner sealing surface (26) of said stationary seat (11).

8. The vacuum-actuated valve assembly (10) of claim 1, wherein said fluid is a gas selected from the gaseous hydrides arsine (AsH_3), phosphine (PH_3), diborane (B2H6), hydrogen (H2) and halide boron triflouride (BF_3), silicon tetrafluoride (SiF_4), germanium tetrafluoride (GeF4), Selenium hexafluoride (SeF6), phosphorus trifluoride (PF3) and oxides carbon dioxide (CO2) and carbon monoxide (CO) as sources of arsenic (As), phosphorus (P), boron (B), silicon (Si) germanium (Ge), selenium and carbon.

9. The vacuum-actuated valve assembly (10) of claim 1, wherein mechanically disengaging the seal to create the open configuration is characterized by an absence of detectable delivery pressure spikes as measured by a pressure transducer and flow excursions as measured by a flow controller.

10. The vacuum-actuated valve assembly (10) claim 2, wherein the elastic-like zone thickness ranges from about 1 microns to about 100 microns at an operating condition of 0 to 2000 psig.

11. The vacuum-actuated valve assembly (10) of claim 1, wherein the delivery pressure is substantially the same as the actuation pressure.

12. The vacuum-actuated valve assembly (10) of claim 1, wherein the open configuration of the valve assembly (10) allows said fluid to flow to an end-user at flow rates ranging from about 0.1-10 sccm.

13. The vacuum-actuated valve assembly (10) of claim 1, wherein said thermoplastic material is polychlorotrifluoroethylene (PCTFE).

14. A sealing structure and mechanism for a valve assembly (10), comprising:

a stationary seat (11) consisting essentially of a thermoplastic material and further wherein said thermoplastic seat (11) is characterized by the absence of elastomeric material;

the stationary seat (11) comprising an opening (28) extending from an outer surface (27) of the stationary seat (11) to an inner sealing surface (26) of the stationary seat (11), said seat (11) further comprising a grooved region (15) extending along said inner sealing surface (26) of said stationary seat (11);

said grooved region (15) of the seat (11) comprising a surface configured to compress within a predetermined zone upon engagement with a top portion (29) of a stabber (12);

the stabber (12) comprising a body portion (30) and the top portion (16) each of which is situated within the interior of the stationary seat (11);

the interior of the stationary seat (11) defined, at least in part, by an inner diameter greater than an outer diameter of the top portion (16) and an outer diameter of the body portion (30) thereby creating a passageway (20) between the stabber (12) and the seat (11);

wherein said top portion (16) of the stabber (12) is adapted to move between a closed configuration and an open configuration, said closed configuration defined by said top portion (16) of the stabber (12) engaged within said grooved region (15) of the stationary seat (11) so as to be maintained in mechanical engagement therealong, said engagement creating a seal that blocks the passageway (20), thereby creating a closed configuration of the valve assembly (10);

the open configuration defined by the top portion (16) of the stabber (12) disengaged from within said grooved region (15) so as to be spaced away from the grooved region (15) along the inner sealing surface (26) of the stationary seat (11) to unblock the passageway (20) and create a gap between the top portion (16) of the stabber (12) and the inner sealing surface (26) of the stationary seat (11) to create an open configuration of the valve assembly (10).

15. The sealing structure and mechanism for a valve assembly (10) of claim 14, wherein mechanically disengaging the seal from the closed configuration to create the open configuration is characterized by an absence of detectable delivery pressure spikes as measured by a pressure transducer and flow excursions as measured by a flow controller.

16. The sealing structure and mechanism for a valve assembly (10) of claim 14, wherein the elastic-like zone thickness ranges from about 1 micron to about 50 microns at an operating condition of 200-400 torr.

17. The sealing structure and mechanism for a valve assembly (10) of claim 14, wherein a delivery pressure is substantially the same as an actuation pressure.

18. The sealing structure and mechanism for a valve assembly (10) of claim 14, wherein said thermoplastic material is formed from polychlorotrifluoroethylene (PCTFE).

19. The sealing structure and mechanism for a valve assembly (10) of claim 14, said grooved region (15) of the seat (11) comprises a coined surface configured to elastically compress within a predetermined elastic-like zone upon engagement with the top portion (29) of the stabber (12).

20. The sealing structure and mechanism for a valve assembly (10) of claim 14, wherein said top portion (16) has a frusto-conical shape.

21. A sealing structure and mechanism for a vacuum-actuated valve assembly (10), comprising:

a stationary seat (11) consisting essentially of a thermoplastic material and further wherein said thermoplastic seat (11) is characterized by the absence of elastomeric material, said seat (11) comprising an opening (28) extending from an outer surface (27) of the stationary seat (11) to an inner sealing surface (26) of the stationary seat (11), said seat (11) further comprising

a grooved region (15) extending along said inner sealing surface (26) of said stationary seat (11); and

a stabber (12) comprising a body portion (30) and a top portion (16);

the stationary seat (11) adapted to receive the stabber (12) having the top portion (16) which is received into the grooved region (15) of the stationary seat (11).

22. The vacuum-actuated valve assembly (10) of claim 1, wherein the gap between the top portion (16) of the stabber (12) and the inner sealing surface (26) of the stationary seat (11) is in a range of 0.0005 inches to 0.010 inches.

23. The sealing structure and mechanism for a valve assembly (10) of claim 14, wherein said top portion (16) extends away from the body portion (16) and terminates as a circular-ring-like structure.